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University of Alberta

Analogical Pictures in Adult Learning

By

Faye P. Wiesenberg

A Thesis

Submitted to the Faculty of Graduate Studies and Research in
Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy

Department of Educational Psychology

Edmonton, Alberta

Fall, 1990

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ABSTRACT

The present study examined the role of analogical pictures in adult learners' acquisition of higher level (abstract) concepts. It was hypothesized that non-notational visuals would act as cognitive tools for all learners, while being particularly facilitative for learners who have a stronger preference and ability to use their visual sensory modality to process information.

The research design was a 2 treatment (instructional condition) X 2 level (high versus low visual learning style) factorial design. One hundred and twenty-nine adult students (average age 30 years) enrolled in three different Northern Alberta post secondary institutions participated in the study. The instructional conditions consisted of two different versions of a text-based, self-instructional booklet; the Text Only version contained verbal instruction, while the Text Plus Analogical Pictures version was supplemented with visuals designed to illustrate the verbal analogy utilized as the main verbal instructional technique. The subject's learning style was assessed by summing their standard scores on an objective (Space Relations subtest of the Differential Aptitude Test) and subjective (Paivio's Individual Differences Questionnaire) measures of imagery. The dependent variable was assessed on two levels: a) knowledge of the concepts, as measured by an open-ended questionnaire; and b) comprehension of the concepts, as measured by a multiple-choice questionnaire. Pearson

Product-Moment coefficients were calculated on all of the variables to explore for inter-relationships amongst them.

The findings indicated that analogical pictures appear to function as cognitive aids for low visual learners in a manner opposite to that hypothesized, lending support to a compensatory model of instructional design. The study also concludes that these factors all appeared to have influenced performance outcomes: a) the learner's profile of verbal and spatial abilities, prior knowledge of the content of instruction, gender, educational and cultural background; b) the learning task's level of complexity; and c) the learners' motivation to complete the learning task. Implications for the design of text-based, self-instructional materials for adult learners in terms of the learner, the learning task and the learning environment are given.

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Chapter I

INTRODUCTION

Purpose of the Study

This study examines the role of analogical pictures in adult learners' acquisition of higher level concepts. While the role of visuals in knowledge acquisition has generally been the subject of intense study over the past several years, the research on this topic has tended to focus on the acquisition of lower level concepts (i.e., knowledge of terminology, facts, classifications and categories). The present study proposes that visual symbol systems that are less notational (i.e., more abstract) hold considerable potential for enhancing adult learners' ability to acquire higher level concepts, called intellectual abilities and skills (Bloom, 1956).

Recently, cognitive theorists have proposed a functional approach to understanding the role of visuals in learning that focuses on explaining how pictures serve to assist learners within a particular learning context (Alesandrini, 1985). This functional view considers more than the physical attributes of visuals, and also examines how an individual learner's cognitive processes and the attributes of specific learning tasks together influence learning outcomes.

The present study uses a cognitive model of information processing and proposes that abstract (i.e., analogical) pictures can serve a transformational function within text-based instruction. The specific cognitive process that is the focus of the study is the subjects' degree of preference for utilizing their visual sensory modality to process information. The study examines how this cognitive "style" interacts with instructional materials designed to facilitate learning of the principles of planning.

Rationale for the Study

The discipline of instructional psychology emerged as a natural development of behavioural and cognitive psychology's interest in the learning process (Pintrich, Cross, Kozma & McKeachie, 1986). Since behaviourism's early pre-occupation with the study of external, situational variables, cognitive psychology has shifted attention to the identification of internal, cognitive variables, individual attribute differences and specific learning task variables that appear to influence learning outcomes (Gagne & Dick, 1983).

In terms of the internal cognitive variables, instructional psychologists postulate that the course of knowledge acquisition proceeds from a "declarative or propositional form" to a "procedural or condition-action form" (Glaser & Bassok, 1988, p.7). This progression from 'knowing what' (i.e., factual information) to 'knowing how' (i.e., being able to apply the information) is considered to be a significant dimension of developing competency and an indication of a qualitative restructuring of a learner's mental representation of knowledge. For instruction to effectively facilitate this more powerful way of processing information (Glaser, 1984), instructional designers have attempted to directly trigger this qualitative restructuring process. Manipulating how learners utilize different cognitive processes that may be based on nonverbal mental representation systems is one strategy that has been relatively unexplored to date.

The learning task variables that have become the focus of research efforts in instructional psychology can be divided into two dimensions, the structure of the task (what is to be learned), and the cognitive processes required to complete the task successfully (how the learning occurs, referred to as cognitive strategies). In terms of the structural dimension, the research to date has concentrated on learning that can be characterized as the simple accumulation of new information in memory, or declarative knowledge. Typically, this learning task is presented to research subjects verbally in a paired-associate learning context, with or without visuals. When the visuals are used as an independent variable, they usually closely resemble the knowledge to be learned and are generally found to influence positively the learning outcome, especially for subjects high in spatial ability. Research on the interaction of visual/verbal instructional techniques and learner visual/verbal sensory modality preference using higher level concepts as the dependent variable has been generally inconclusive (Arter & Jenkins, 1977; Cronbach & Snow, 1977).

In terms of the process dimension of the learning task, most of the research to date has attempted to identify what constitutes "efficient" cognitive strategies. One of the most consistent findings is that strategies vary in efficiency, depending on the nature of the learning task, prior knowledge and cognitive abilities of individual learners, and the strategies that learners spontaneously use. One spontaneous strategy utilized by every learner has to do with their sensory modality (auditory, visual, tactile or verbal). A strong preference for using the visual sensory modality is currently being referred to by researchers as a "visual" learning strategy or style (Richardson, 1980).

Many attribute treatment interaction (ATI) studies that have examined the interactive effects of making instruction less verbal by adding visuals to verbally-based instructional materials have concluded that, other things being equal, people with spatial and abstract abilities stronger than verbal ability benefitted more from visual treatments than exclusively verbal treatments (Cronbach & Snow, 1977).

In a recent review of the research on human factors, education and psychology related to the use of visuals in instruction, Friedman (1986) concluded that the value of this enormous body of research is handicapped by a number of serious methodological problems tied to the absence of a sound theoretical framework. Friedman's concerns centered on the current absence of sufficient information to guide the development of accurate visual representations of different types of information, and methods for determining which visual presentation is optimal for various types of learners. Friedman stated that while traditional A.T.I. research that examines broad interactions is useful, a closer examination of the interaction of the new knowledge and individual learner's methods of representing knowledge is a more fundamental issue in theory building.

The issue of the role of visual symbol systems in the learning process has been the focus of a lively debate between theorists holding two opposing views of the nature of mental representation. On one side of the debate are theorists who favour a more process-oriented view of cognition, and postulate only one verbal-like code for representing knowlege. On the other side of the debate are theorists who postulate the existence of at least two (verbal and visual) and possibly more modality-specific codes for representing knowledge. The implications that these two views hold for the role of visual symbol systems in the design of instructional materials are quite different. A clearer understanding of how visuals influence learners' cognitive functioning would significantly enhance the field of instructional psychology.

The discipline of instructional psychology is currently in the early stages of theoretical development regarding the role of visual symbol systems in learning. The role of non-verbal and non-representational symbol systems in the acquisition of higher level concepts (ie."procedural" knowledge or intellectual abilities/skills) is one area that has received relatively sparse research attention.

An additional challenge for instructional designers in adult education is the growing demand for self-instructional materials that allow adult learners to acquire new knowledge at their own pace and in their own setting. An instructional framework that utilizes non-verbal symbol systems appropriately to assist learners to acquire higher level concepts could increase the ability of all learners to learn independently.

The present study proposes that analogical pictures embedded in competency-based instructional materials will function as "cognitive tools" (i.e., conceptual bridges between existing and new knowledge) for all adult learners, while resulting in significantly higher performance outcomes for those adult learners with a strong natural visual information processing style.

Chapter II

REVIEW OF THE LITERATURE

Chapter Two describes a cognitive model of information processing and key concepts related to the central questions addressed in this study. Three theories of mental representation are reviewed, as is the construct of mental imagery, as it relates to fairly well defined educational learning tasks. Symbol system theory is discussed as it pertains to the role of visuals in instruction. Chapter Two concludes with a discussion of the model of teaching upon which the instructional materials designed for this study were based, and the research questions addressed in the study.

The Information Processing Model of Learning

This section briefly outlines those aspects of the information processing view of cognition that are most relevant to the focus of the study. First, particular attention is given to Atkinson and Shiffrin's (1968) multistore model of memory, describing the manner in which information is initially encoded in short-term memory, transferred to long-term memory and subsequently retrieved when needed. Cognitive functioning is discussed in terms of the structures and processes that cognitive psychologists believe account for the differences between effective and ineffective learners.

Memory and learning. Within a cognitive framework, the information processing model of learning is primarily concerned with the way people perceive, organize, store and retrieve information from their environments. Adherents to this model have attempted to understand the processes underlying learning by studying how people remember new information while performing quite well-defined and often timed experimental tasks.

Atkinson and Shiffrin (1968) proposed a multistore model of memory that describes information acquisition as occurring in three stages corresponding to three structures of the human memory system. The first of the stages of memory is described as attending to stimuli, and encompasses the processing of new information from when it first enters the sensory register to just before it enters long-term memory. Atkinson and Shiffrin initially described only a visual sensory register, but later expanding the model to account for memories of other sense modalities (auditory, motor and tactile) (Baine, 1986).

In the first stage of learning, information from the environment, primarily in the form of visual, auditory or tactile stimuli is initially screened into or out of memory by the sensory register (the first structure of the memory system). If retained and selected for further processing, the information enters short-term memory (the second structure) and is encoded. Eventually, some of this information is transfered to long-term memory (the third structure). Other models of memory describe another structure called "working memory" that screens information into and out of long-term memory (Best, 1986).

In addition to these structural features of memory, Atkinson and Shiffrin's model also refered to control processes that subjects use to manipulate information once it is in long-term memory. These processes are a function of the perceived nature of the new information, and individual characteristics of learners. Two different processes are important in the transfer of information into long-term memory; rehearsal and coding. In terms of long term retrieval, coding is thought to be the more significant process, and research seems to indicate that this coding can be of acoustic, verbal or visual information (Baine, 1986). Coding also involves the transformation of incoming information into a more memorable form, primarily through linking it to already encoded information. Once encoded, information is generally thought to be hierarchically arranged, with a distinction existing between higher process-oriented knowledge (referred to as "procedural") and lower structural knowledge (referred to as "declarative") (Tulving, 1984, 1985).

The final stage of learning has to do with both the long-term storage of encoded information and its retrieval from storage for application when needed. The efficiency of

This storage and retrieval process is believed to be [illegible] related to the manner in which the incoming information was initially coded and integrated with a learner's [illegible] existing information or knowledge structures or [illegible] (Bell-Gredler, 1986). Research on the differences between novice learners (those with no prior knowledge of the subject matter) and expert learners (those with a broad conceptual understanding of the subject matter) seems to indicate a qualitative difference in the way these two kinds of learners process new information.

Some theorists have proposed that one of the key differences between effective and ineffective problem [illegible] (as opposed to expert versus novice learners) lies in an ability to transfer knowledge from one situation to another by finding correspondences between the existing [illegible] or schema, and the incoming information ([illegible], 1983). The process of making new knowledge [illegible] by relating it to prior knowledge [illegible] analogical reasoning.

Reasoning by analogy involves a [illegible] as "mapping" that can be broken [illegible] stages: 1) construction of mental representations of existing information and the target [illegible] forming a match between the [illegible] drawing inferences from existing information [illegible] information; and [illegible] a common [illegible] two to either incorporate the new knowledge meaningfully into long-term memory or generate a solution to a novel problem (depending on the learning task) (Holyoak, 1985; Gentner, 1989). According to Bloom (1956) the act of devising a nonliteral analogy employs at least four and possibly five cognitive processing levels: knowing, comprehending, analyzing, synthesizing and evaluating.

The use of analogies in instruction appears to be particulary effective in facilitating comprehension of abstract concepts (Burns & Okey, 1985), possibly because analogical thinking also tends to involve a visual element allowing verbal processing to represent nonverbal conceptualizations (Jorgenson, 1980; Templeton, 1973). One reason for this may be that analogies can make new information more imaginable, or "concretize the abstract" (Royer & Cable, 1976). Knowlton (1966) suggested that analogical pictures (or, any realistic representation that refers to something else in terms of its appearance or function), by portraying the nonphenomenal in a visual world, can create a conceptual bridge to the phenomenal world. Some theorists have argued that different internal representations are used for processing verbal versus figural/visual analogies (Shalom & Schlesinger, 1972, cited in Sternberg, 1977).

According to schema theory, effective analogical reasoning requires a learner to have relevant old schemas stored in memory, as well as be able to recognize the relevance of these schemas to a new situation (Best, 1986; Weinstein & Mayer, 1986). As well, the new information must be represented to a learner in a form that he/she typically uses to encode information before a link between the old and new information can be made. As the nature of the new information becomes more abstract, the similarity between the old and new schema must be obvious enough for the old schema to be seen as relevant and subsequently utilized (Gick & Holyoak, 1983). Overall, the use of analogy has proven to be quite an effective tool in new knowledge acquisition.

Cognitive functioning. Information processing theorists have attempted to understand human functioning in terms of the mental processes contributing to task performance (Sternberg, 1985). While the theorists have focussed on process, they have also acknowledged the existence of mental structures and spatial visual elements that together account for individual variations in cognitive functioning (Snow, 1976). The ability of an individual to use analogical reasoning has long been recognized as a significant contributing element to overall cognitive functioning (Rumelhart, 1977; Sternberg, 1977).

The three components that make up the structural elements of cognitive functioning are crystallized, analytic and spatial. Crystallized or verbal-educational abilities appear to depend on the existence of prior knowledge (Glaser,

1984) and specific skills relevant to information retrieval (Corno & Snow, 1986; Gagne, 1985). Analytic or fluid abilities represent the ability to generate solutions to novel and complex problems and appear to be higher order cognitive skills (eg. analogical reasoning) (Bloom, 1984). Spatial or visualization abilities refer to the skills needed for processing complex figural and spatial information (Kozma & Bangert-Drowns, 1987).

This view of cognitive functioning sees the learner as fitting somewhere along a continuum of high versus low processing skills across crystallized-verbal, fluid-analytical and spatial-visual domains. All three domains are highly interrelated in terms of the overall performance of the learner. One of the differences between effective and ineffective performance appears to lie in the way a learner processes information, as well as in how well matched the cognitive demands of the performance task are to a learner's profile of crystallized, analytic and spatial cognitive skills.

In summary then, a multistore model of memory is a useful conceptual framework for understanding learning. How information is represented in memory becomes an important consideration for desiging instruction that can utilize an individual learner's memory structures. Current research on cognitive functioning indicates that individuals vary in terms of how they process new information and relate it to existing information in memory. Research on the role of specific perceptual modalities in cognitive processing could improve the ability of instructional designers to assist individual learners to use their modality-specific memory structures more effectively.

Theories of Mental Representation

Three schools of thought regarding the way information is stored in memory are categorized here as Propositionist, Pictorialist and Interactionist. The salient features of each and the implications they hold for the design of instruction is briefly described in this section.

The propositionist position.

Propositionists believe that information is stored in long-term memory in the form of semantic propositions or verbal strings, and that visual images may be stored in short-term memory only as very brief artifacts of the perception process. The construct of mental imagery is therefore defined in terms of the perceptual cognitive process, and viewed only as a secondary and transitory outcome of the initial stages of information processing. Another name given to this model is "single code", as all information stored in long-term memory is considered to be coded as propositions only (Levie, 1987).

This approach to understanding mental representation is "top-down" in that it emphasizes the role of logical reasoning and deduction to theory-building, and the existence of generic schemas onto which new information is somehow attached. This view is also considered a process-oriented or "constructive" approach to cognition (Neisser, 1967). Propositionists describe the construct of mental imagery through the use of analogy (since images do not really 'exist' in long-term memory) and have devised a computational conceptualization of mental representation that assumes that any information, regardless of its original form (pictorial or verbal) can be represented by a discrete code, such as the binary system in computers (Anderson, 1978; Kosslyn, 1981).

Proponents of the propositionist point of view have developed a series of verbal network models that represent verbal information relationships visually, and conceptualize memory retrieval as analogous to searching for needed information among a network of concepts (nodes). Differences between learners' ability are explained in terms of differences in the strength of the connections they have established between concepts in memory (Best,1986). Once in long-term memory, information is seen as likely to be changed to fit into already existing conceptual schemas to become more comprehensible to the learner.

In terms of instruction, the propositionist approach emphasizes the building of semantic knowledge and the provision of verbal overviews to assist learners to link new information to already existing internal conceptual schemas.

The pictorialist position. Pictorialist theorists describe two functionally independent but inter-connected symbol systems (imaginal and semantic) for storing information in long-term memory. They believe that people think in both pictures and words. The pictorialists' main proposition is that new incoming information is linked to already existing knowledge schemas that are both imaginal and semantic. One of the key proponents of the pictorialist position is Paivio (1972, 1986).

Paivio's "dual code" model bases its theoretical constructs on behavioural operations inferred from observable performance in experimental tasks. This approach is referred to as "bottom-up" in that it emphasizes the role of empirically derived 'facts' in theory building.

Paivio's structuralist point of view describes two separate visual and verbal information coding systems that operate both independently and interdependently according to associationist principles (Yarmey, 1984). Paivio proposed that information is initially coded either in a visually or semantically-oriented mode, depending on both the ease with which the information can be pictured and the preference of the perceiver to process information using primarily either the visual or verbal/auditory sense modality.

Paivio's research has concentrated on the use of symbol systems that are highly representational. He believes that information that is not imaginable (i.e., more abstract concepts) is more efficiently coded verbally, and his imagery research has concentrated on declarative, or what he calls "concrete" knowledge acquisition (Paivio,1986). Richardson (1980), another pictorialist, disagrees that the manner of coding information is dictated solely by its concreteness, and presents evidence that it is primarily the imaginability of stimulus material that determines how easily it can be remembered.

In terms of designing instruction, pictorialists emphasize the utilization of both the visual and verbal/auditory sensory modalities by the provision of pictorial aids to help learners acquire new information that is highly imaginable and/or concrete in nature. While Paivio chose to concentrate on the verbal/auditory and visual modality information processing preferences, he and others (see Rogers, 1983 and Yuille, 1983) have speculated on the existence of additional modality specific processing codes that would also have implications for designing instruction.

In spite of research findings that point towards an integrative approach to processing information (Marschark & Paivio, 1977), Paivio still holds a basically pictorialist position on mental representation.

The interactionist position. The interactionist perspective is the most recent approach to mental representation. Grounded in information processing theory, the approach is neither pictorialist nor propositionist, but appears to be a composite approach that is qualitatively different from either.

In one interactionist model that appears to extend the pictorialist or dual-code model, Potter (1979) presented a "conceptual" model of mental representation that put perceptual/imaginal and verbal concepts on an equal footing in terms of influence within the comprehension process. In this conceptual model, the comprehension of verbal symbols parallels perceptual/imaginal comprehension, and both depend on the activation of the same abstract ideas. Instead of two functionally distinct systems of knowledge (perceptual/imaginal and verbal/abstract), Potter's model proposed that all knowledge is part of a single system with words, pictures and perceived objects all representing equivalent routes to the same concepts. He further suggested that superordinates or "meta-concepts" are represented in some form that is neither visual nor verbal but is more accessible to visual than verbal inputs (see Marchark & Carrol, 1984, for support of this model).

In a review of recent research on perception and representation, Kolers (1983) pointed out how the propositionist-pictorialist standoff rests on misconceptions about how each camp perceives the nature of mental imagery; as a picture in the mind or as something else, typically described as a list of verbal statements. Kolers offers Goodman's theory of reference as an alternative way of looking at the issue. Goodman (1968) uses five criteria that refer to the articulateness versus density of the symbol systems, rather than the semantic versus pictorial aspect, as a means of distinguishing between symbol systems. Goodman's diagnostic criteria of notationality contains both semantic and syntactic requirements, which give verbal language and pictures both the ability to vary along a continuum in terms of notationality.

Kolers' model of mental representation describes cognitive processes as skills in the manipulation of personal and consensual (communal) symbols that vary in terms of notationality (Kolers & Smythe, 1979, 1984). Kolers suggested that all knowledge is fundamentally procedural and that varying skill levels in different modalities will influence the kind of symbol systems that an individual can manipulate.

Identical research results in this area have been used to support all three positions (see Paivio, 1986). As a result of a great deal of debate, a number of theorists now appear to have a foot in both the pictorial and propositionist camps in terms of the way they describe the manner in which images are represented. Kosslyn (1980), who previously appeared to be taking a pictorialist stand, now describes the experience of imagery as pictorial in short-term memory but propositional in long-term memory. Shepard (1981), also a former pictorialist, now describes the phenomenon of perception and mental imagery as analogous. Anderson (1983), a former propositionist, in the latest formulation of his computational ACT theory of cognition, clearly allowed for the existence of a separate system for visual-spatial images to represent nonverbal declarative-type knowledge.

Anderson expressed the opinion of many imagery theorists when he stated that it is not possible to decide which position is "right" on the basis of experimental data. In support of this view, Kolers (1983) pointed out that the issue of mental representation is further complicated by a number of individual difference variables, such as a learner's prior knowledge and experience with the content domain, the nature of the imagery instructions given to the learner, and his/her ability to visualize: "Perceptions are symbols that stand for or represent external objects or events...are experienced by each person privately" (p.155). Goodman (1982) suggested that people think in both words and pictures, as well as in a number of other ways dependent on the manipulability of the symbol systems available to them.

In conclusion, it appears that current thinking on how knowledge is represented in memory is moving away from a propositional versus pictorial dichotomy towards a much more complex model of knowledge acquisition as a function of the nature of the knowledge, the profile of skills of the individual learner, and the specific learning context. Taking a generally flexible stand on the issue of mental representation and postulating the feasibility of a "transformational" interactive process between visual and nonvisual knowledge structures, the interactionist position is consistent with current thinking on the need to design instruction that takes into consideration all three components of instruction: a) learner's cognitive processing style, b) the specific content of instruction, and c) the nature of the knowledge to be acquired.

Pictures and Learning

This section overviews symbol systems theory using Goodman's (1968) concept of notationality and the implications that the use of symbol systems hold for instruction. Research on the role of pictures, and the closely related concept of mental imagery, in knowledge acquisition is reviewed primarily as it relates to classroom-type learning tasks and the adult learner.

Symbol systems theory. Goodman (1968) considered a symbol anything that stands for or represents anything else by denoting, depicting or exemplifying it, and that all symbols conform to syntactic (structural) requirements as well as referential (semantic) requirements. If a symbol system contains all five of Goodman's diagnostic features, it is notational (and usually highly realistic) and is therefore open to straightforward interpretation. Using this criteria, words that have a single referent and are syntactically disjoint (stand on their own in terms of their meaning) are seen as notational, while pictures that have more than one referent and are syntactically dense (their meaning depends on their context), are seen as non-notational (abstract). Other forms of denotation, such as diagrams and graphics, typically fall somewhere along this continuum of notationality.

Salomon (1979), in reference to how symbol systems interact with cognition, described symbols as "bearers of extractable knowledge" (p.29) that serve as character or coding elements (i.e., marks) organized into schemes according to specific rules of combination. These symbol schemes become symbol systems that differ in terms of their notationality. Referring to Goodman's criteria, Salomon suggested that as one moves along this continuum from complete notationality (or realism) to complete non-notationality (or abstractness), the way that the learner interprets the information implied by the symbol system varies considerably, depending on a number of learner and task variables. How any single symbol functions in terms of its notationality also depends on its relationship to other symbols within the same system. Salomon drew a number of conclusions about how knowledge is represented in memory that have important implications for instruction:

1. all knowledge is stored in memory symbolically;
2. not all symbol systems are equally well suited to express, describe and depict knowledge; highly notational systems tend to be less flexible than

highly non-notational systems;

3. some kinds of symbol systems can facilitate learning by depicting mental operations that the learner may not have yet acquired (i.e., be transformational or 'tools for thought'); and
4. learners differ to the extent that they can utilize external symbol systems to activate their own internal mental operations.

Salomon suggested that the utilization of different symbol systems demands different cognitive processes on the part of the learner, and he described the two primary kinds of symbol systems (visual and auditory-linguistic) in terms of how they serve to activate a learner's sensory systems and cognitive processes. The use of a particular symbol system to represent knowledge to a learner will be effective only to the extent that it corresponds to the way that the learner internally represents knowledge, as well as to the extent to which the symbol system facilitates the kind of information processing required of a learner within a particular learning context.

Gardner and his associates (Gardner, Howard & Perkins, 1974) warn about the replacement of dichotomies like visual-verbal by Goodman's continuum of notationality. While giving educators an analytical tool for designing instruction, the uncritical adoption of a model like Goodman's may result in a loss of "aesthetic" sensitivity on the part of the learner.

If one accepts that individuals must learn to manipulate different symbol systems (Kolers & Smythe, 1978, 1984), cognitive development theory suggests that as learners get older, movement away from non-notational towards notational or linguistic approaches to instruction is more appropriate. By adulthood, the exclusive use of notational instruction is often the case. This traditional approach to instruction has been questioned by educators in the visual arts (Arnheim, 1969, 1974), as well as those in the visual literacy movement (Sinatra, 1986; Zimmer & Zimmer, 1978).

Research findings.

i) *Mental imagery*. The cognitive process that describes the relationship between knowledge and the various visual symbol systems available to learners is referred to by cognitive psychologists as mental imagery (Best, 1986). Richardson (1969) defined this construct as covering the entire range of imagery phenomenon (subjective and objective).

> Mental imagery refers to (a) all those quasi-sensory or quasi-perceptual experiences of which (b) we are self-consciously aware, and which (c) exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts, and which (d) may be expected to have different consequences from their sensory or perceptual counterparts (p.2-3).

Research on mental imagery and learning indicates that the effectiveness of imagery as a learning tool is related to a learners' spatial-visual ability, the nature of the learning task, as well as the kind of imagery instructions given. As research on the construct of mental imagery closely overlaps with that on the use of actual pictures, the discussion in this section will frequently overlap with that in the next section on pictures.

Levie and Lentz (1982), in their extensive review of research on the effects of text illustrations, found that the well-documented overall positive research findings on the effects of using mental imagery are reduced if learners are young (consistent with findings by Pressley, 1977), have poor drawing ability or are just unable to process information visually.

Taylor (Taylor, Canelos, Belland, Dwyer & Baker, 1987) evaluated the use of embedded imagery cues (pictures of new information) and verbal, attention directing strategies (instructional questions) on college students' acquisition of verbal information about the heart. The results of the study indicate that the best visual performance outcome came from a combination of embedded imagery and verbal cues and externally paced software format. The imagery cue also appeared to assist in the learning of verbal information. Taylor and his colleagues speculated that the self-paced learners (those who controlled their rate of instruction) did not perform as well as the externally-paced learners (who could not control their rate of instruction) because the self-paced learners used their own less efficient cognitive strategies rather than the unfamiliar embedded ones.

Sternberg and Weil's (1980) research with adults supports the hypothesis that the efficiency of a verbal versus visual information processing strategy depends on a learner's natural inclination to use either verbal or visual strategies, in spite of any imagery instructions they are given. They found that their subjects' successful utilization of one of four strategies (linguistic, spatial, algorithmic, or mixed) in solving linear syllogisms was a function of each subject's particular pattern of verbal and spatial abilities. The authors were able to alter a subject's use of a particular strategy only when the subject possessed the required verbal and spatial abilities to use the new algorithmic strategy.

Kyllonen (Kyllonen, Lohman & Snow, 1984) were also interested in the potential interaction of learner aptitude, strategy training and task characteristics. They found that while strategy training (verbal-analytic, visual, modeling) and performance feedback significantly improved the learner's ability to successfully complete a spatial visualization task, the treatment effect was influenced by the learner's profile of crystallized, fluid-verbal and spatial-visual abilities. The major findings of the study indicated that:

a) high fluid-verbal and crystallized ability subjects performed best when allowed to use their already efficient cognitive strategy; b) strategy shifting was required for all subjects for them to meet some aspects of the experimental task; c) low ability (across all three cognitive domains) subjects appeared to be helped by modeling strategy training; d) low fluid-verbal, spatial-visual but high crystallized ability subjects were best helped by verbal strategy training; and e) task difficulty (in terms of degree of spatial ability required) sometimes overrode these other factors. Overall, these researchers found the subjects' choice of strategy very inconsistent, with each subject shifting from strategy to strategy to accommodate to their own strengths and the task demands. The strategy training was most beneficial when it allowed the subjects to captitalize on their particular cognitive strengths and compensate for their particular weaknesses.

Lohman (1984) also analyzed the strategy shifting that appears to happen in spatial tasks to investigate the hypothesis that spatial tasks tap different abilities in different subjects. He concluded that his undergraduate subjects differed in their solution strategies according to their prior knowledge of the task domain and how they mentally represented the initial stimulus task. His observations of strategy shifting differed from those of Kyllonen (Kyllonen et al, 1984) in that Lohman's subjects appeared to shift in a predictable manner according to whether they perceived that the spatial task required verbal-analytic skills or spatial-analogy skills.

Much of the research on mental imagery has focused on its role in the learning of concrete concepts that can be represented in symbol systems on the notational or representational end of Goodman's (1968) continuum. The use of mental imagery with these kinds of learning tasks has clearly proven facilitative in many learning situations (Dwyer, 1978; Friedman, 1986; Levie & Lentz, 1982), particularly with learners who prefer to use their visual sense modality to process information (Paivio, 1986) and have objectively measured higher levels of spatial-visual ability (Lohman, 1979). Research on the use of non-notational (or more abstract) symbol systems to acquire the higher level concepts that underlie skillful action is less conclusive.

Kaufmann (1980) made a case for the increasing functionality of imagery as the learning task increases in ambiguity and novelty. His position was that while language is the most important symbolic instrument available as a tool of thought, it is generally limited by its conceptual grounding to conventional aspects of knowledge. Because visual imagery has no such limitation, it is more conducive to open-minded exploratory activity. Kaufmann has found support for his case for the "transformational" value of imagery in studies on creative problem-solving in which subjects used visual metaphors and pictorial analogies to find new ways of solving relatively simple but novel problems.

Krueger (1984), in an exploration of the role of imagery in creative problem-solving, made a similar case for its role in higher level cognitive processing. He used a verbal-logical tracking process to study how creative engineers solved novel problems. He discovered that the initial stages of their solutions always included the use of visuals. One third of the pictorial associations used by these scientists were analogies, in the form of pictures of familiar concepts used as springboards to conceptualizing the novel problem situation. Krueger concluded that the images facilitated problem-solving because they allowed the problem solver to see the spatial and geometric relationships within the problem, giving them a "graphic overview" of the problem as a whole.

Miller (1984) examined the role of imagery in scientific thought, and concluded that mental imagery in auditory and visual modes was critical in a number of the major scientific conceptual breakthroughs in twentieth century physics. He described how scientists who made major contributions (such as Einstein, Boltzman, Poincare, and Bohr) relied on visual thinking, often in the form of analogies.

In summary, mental imagery appears to have a role in facilitating both higher and lower level concept learning.

The use of analogical visuals, either embedded or spontaneous, appears to be of particular importance in higher level cognitive processes. All other things being equal, the effectiveness of mental imagery seems to depend on a learner's particular profile of cognitive abilities, preferred manner of using these abilities, and on how he/she represents information in memory.

ii) Pictures. This section reviews research on the role of experimentor provided visuals (pictures, diagrams and charts) in text-based and computer-based instructional materials.

Over the past twenty-five years Dwyer and his associates have demonstrated that supplemental pictures assist in learning from text-based programmed instructional materials (Dwyer, 1978; Dwyer, 1987). This large body of research has concentrated on investigating the effects of pictures varying in their degree of "realism" on subjects' memory about and understanding of the anatomy and physiology of the human heart. Dwyer has concluded that for certain educational objectives, visual presentation is not facilitative, due to a myriad of variables not related to the specific features of the visual stimuli. Key amongst these variables are individual learner characteristics such as learning style, cultural background, general profile of cognitive abilities and prior knowledge of the instructional content.

Numerous studies have looked for the interaction of instructional condition and various learner, cognitive abilities with inconclusive results. While there seems to be consistent support for the addition of nonverbal or figural presentations to difficult (i.e., higher level) verbal instructional materials with lower verbal aptitude learners, overall evidence for the interaction of differential aptitudes if not impressive (Cronbach & Snow, 1977). Cronbach and Snow concluded that general ability is the strongest predictor of learning achievement, with strictly verbal treatments tending to benefit persons lower in prior knowledge of the subject content, and visual treatments tending to benefit persons higher in prior knowledge. Overall, persons with spatial and abstract abilities stronger than verbal ability appear to benefit more from visual treatments. In the course of their review of the research, Cronbach and Snow raised two critical issues. The first is the need to examine the supposition that verbal ability implies the ability to learn from verbal treatments, while spatial ability implies the ability to learn from spatial treatments. Instead, the authors speculated that well designed spatial treatment can act as a prothesis for a student who has poor spatial ability. The second issue is the need for more sophisticated hypothesis testing "based on a careful analysis of the information processing required in the course of learning" (page 292).

Levie and Lentz (1982), examining more specifically the relationship between the visual and print subject content of instructional materials, generated nine guidelines for the use of illustrations in text. They proposed that illustrations serve four basic functions for the learner: a) attentional, in attracting and directing a learner's attention; b) affective, in affecting emotions (such as increasing enjoyment) and attitudes; c) cognitive, in facilitating learning by improving information acquisition, comprehension and retention; and d) compensatory, by accommodating poor readers. In terms of the cognitive function, their review of primarily representational pictures in verbal concept learning, suggested that the addition of this kind of "concrete" picture to "abstract" text appears to somehow facilitate higher level concept comprehension.

Hodgsen (1985), in a comprehensive review of the research on the key variables related to visual communication design, described a number of functions that visuals play in videotext. These functions appear to elaborate on those outlined by Levie and Lentz (1982) and are: a) to lighten the processing load for the human user and aid retention; b) to communicate information and reinforce content; c) to attract, direct and hold attention and interest, as well as break up and relieve the monotonous text; and d) to save space by replacing lengthly verbal explanations. Hodgsen also concluded that visuals and text can work together to provide a system of communication that can accommodate language differences across learners.

Stein (Stein, Brock, Ballard & Vye, 1987) investigated the conditions under which verbal and representational visual elaborations (presentation of non-redundant information in either words or pictures) facilitate learning. Their findings, also building on those of Levie and Lentz (1982), indicated that visual illustrations presented or imagined during the encoding of verbal information can either facilitate or hinder comprehension and learning, depending on whether or not they help to clarify a confusing verbal relationship between concepts being learned. Visual images that simply represent the key verbal concept without adding to the overall information available to the learner may actually interfere with information retention by diverting the attention of the learner away from the learning task.

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Research has pointed out the importance of verbal ability as a key intervening variable in learning, and the complexity of the relationship between spatial ability and performance on tasks requiring visualization. Winn's (1981, 1982a) studies revealed that higher verbal ability subjects use pictorial and organizational aspects of flow diagrams differently than do lower verbal ability subjects. While the spatial treatment helped higher verbal subjects in a science classification task, it did not help low verbal subjects. This finding implies that instructional materials in some subject areas may need to be designed differently for students with different abilities. Given that learners' visual skills and learning strategies vary to the degree to which they can be controlled through instruction, and to the degree to which they may even be effective with different kinds of learning tasks (Sternberg & Weil, 1980), Winn (1982b) supported the use of analogy as a strategy for creating new knowledge structures. He suggested that the analogical link can be effectively established by means of a visual image.

Alesandrini (1984, 1985), in a review of the research on the use of visuals with adults in classroom-like learning situations, came up with a functional model for how each major visual type (representational, analogical and abstract) plays a unique role in the learning process. Her conclusions about the role of representational visuals are similar to those offered by other key researchers (see Dwyer, 1978, Levie and Lentz, 1982 and Winn, 1982b), while pointing out that the achievement of lower ability students tends to decrease as the degree of realism in the visual increases (see also Dwyer & Parkhurst, 1982). Alesandrini suggested that one possible reason for the lack of consistent results in studies of analogical and abstract visuals was the lack of clear standards for designing visuals to represent more abstract concepts.

Alesandrini suggested that analogical visuals, which convey concepts by showing something else (usually a concrete object) and implying a similarity, are especially useful for teaching abstract concepts. As previously noted, this type of visual seems to be particulary helpful in teaching lower ability and novice learners abstract concepts. Mayer (1975) found that adults with no prior knowledge of computer programming performed better in programming tasks when given visual analogies for computer components (such as a trash can to represent the delete function) than did adults who were not given this visual assistance. Visual analogies are also the type of visual most frequently utilized by high ability creative problem-solvers (Krueger, 1984; Miller, 1984). Research with animated visual analogies that changed form as the concept was developed, found better learning of complex scientific concepts, as well as more positive student attitudes toward learning, than did verbal only presentations of the same subject matter (Alesandrini & Ridgney, 1981; Ridney & Lutz, 1976).

Alesandrini's abstract visuals are non-representational diagrams of concepts that are related logically or conceptually (such as graphs, flowcharts, and cognitive maps). Studies of the effectiveness of these visuals suggest that they can facilitate learning only if a learner already possesses higher order cognitive skills.

Considering all of the key research results, Alesandrini recommended that instructional designers use analogical visuals to relate new information to prior knowledge, abstract visuals to further convey the essence of the new information, and representational visuals to still further define and distinguish new from old information.

In summary, there does not appear to be much doubt that text-based instruction, supplemented with visual representations of some key concepts, is superior to verbal instruction alone, especially for learners who are less proficient in manipulating verbal symbols. It also appears that the addition of analogical visuals to function as "cognitive tools" may offer additional potential for the development of instructional materials for learners more proficient in manipulating non-verbal symbol systems.

Designing adaptive instruction

This section of the literature review begins by presenting a model of instructional design that considers each key component of instruction in terms of its ability to be adapted to the individual learner's profile of capabilities, the cognitive processing demands of the learning task, and the situational context of instruction. Research reviewed here focuses on adult subjects learning higher level concepts thorough the use of self-instructional materials.

Instructional design as a systematic process in which every component (instructor, learner and instructional material) is considered crucial to successful learning has evolved over the past twenty years primarily from three key areas of research. The first two were research into each of the individual task and environmental components of the learning context that positively affect learning, while the third was research into aspects of the learning process that appear to be related to effective learning (Dick & Carey, 1985; Gagne & Briggs, 1979; Kulik, Kulik & Cohen, 1979). For adult educators, the adult learners' desire for self-directed instruction and learning goals that are immediately relevant to their current learning needs are additional important instructional design issues (Brookfield, 1986; Gagne & Driscoll, 1988).

A key step in the systematic design of instruction is to determine which of the task and environmental variables that can be adapted affect the intellectual functioning of the learner. Gagne and Briggs' (1979) theory of instruction, which outlines five types of learning outcomes and nine events of instruction for optimizing learning, information retention and transferability, is currently considered to be a sound basis for integrating what researchers are discovering about these "adaptive" variables (Gagne & Dick,1983).

In addition to a model of instruction, a system is needed that will integrate what is known about the learning process, the individual learner's abilities and motivation, and the specific learning outcomes desired. Corno and Snow's (1986) model of "adaptive teaching" addresses the individual differences among learners from the perspective of learner adaptation to the learning environment and teacher/instructional material adaptation of this environment to a learner. Their model considers teaching to be adaptive to the extent that it is appropriately tied to a valid assessment of a learner's cognitive processing style and capabilities. Once this ability variable is controlled, the learner's motivation is also generally positively affected (Dweck, 1986).

Corno and Snow's taxonomy of instruction considers how the instructional method may act as an intermediary agent (between the learner and the new learning) in affecting the learning outcome. Their instructional methods vary in the extent of control over the instruction a learner is allowed, and in the amount of cognitive processing demanded of the learner. The methods range from those that "short-circuit" cognitive functions by compensating for learner processing weaknesses to those that "activate" the learner to use higher level cognitive skills that are already in their cognitive strategy repertoire.

Gagne's (1985) nine instructional events, all of which direct the cognition of the learner, form the components of the method (short-circuiting) used in the design of the instructional materials in this study: gaining attention, informing the learner of the objectives, stimulating recall of prior knowledge, presenting stimuli, providing guidance, eliciting performance, and enhancing retention and transfer. This instructional method also forms the basis of Bloom's (Bloom, Hastings & Madaus,1971) mastery learning method, developed initially for academic non-achievers but now used with both high and low ability learners, as well as novice learners (Block,1974). Mastery learning operates on six basic principles: a) the content of instruction is individualized, b) the student is active in the learning process, c) the goals of learning are clear and explicit from the onset, d) concepts are presented in small clusters, e) corrective feedback and evaluation is provided on an ongoing basis, and f) the learner controls the pace of instruction (Cross, 1976).

One of the most popular and widely studied mastery learning systems used with adults is Keller's Personalized System of Instruction (PSI). PSI courses are mastery-oriented, individually-paced, and use lectures for stimulation and motivation only. Printed study guides are used for communication of the instructional information, and student proctors are used for quiz evaluation (Kulik, Jaska &

Kulik, 1978). A meta-analysis of PSI effectiveness studies concluded that PSI was significantly better than non-mastery conventional teaching methods in a number of ways and across a number of learning environments (Kulik, Kulik and Cohen, 1979). Most notably, PSI raised final examination scores (measuring both higher and lower cognitive skills) of learners from the 50th to the 70th percentile. In addition, learners rated PSI classes as more enjoyable and cognitively demanding than their conventional classes.

Tobias (1979) examined the effect of anxiety on learning in several educational contexts and proposed that the level of learner anxiety can be seen as a function of the cognitive processes/strategies that are available to learners throughout instruction. If a learner is able to manipulate the flow of instructional information and obtain assistance in structuring the learning task to suit her/his own cognitive processing capabilities, then anxiety may be lowered and performance improved. Tobias's recommendations are consistent with those of other researchers who have studied the interaction between anxiety, ability level and learning, with high anxious and low ability learners generally achieving better results in highly structured, low cognitive demand, instructional approaches (Gagne & Dick, 1983; Sieber, O'Neil & Tobias, 1977).

In summary, Corno and Snow's (1986) model of "adaptive" teaching describes an approach to designing instruction that moves the learner along a continuum of low cognitive demand to high cognitive demand strategies, according to a number of key learner characteristics (such as abilities, prior knowledge, motivation and anxiety). The research on instructional design supports instructional methods that allow learners to capitalize on their naturally preferred cognitive processing style, while indicating that how the learner processes information (visually or verbally) can be somewhat modified through design variables (Sternberg & Weil, 1980; Taylor et al, 1987; Winn, 1982b). One can reasonably assume then, that instructional materials that combine the effective features of Corno and Snow's model with a feature that allows learners to use their preferred method of processing information should enhance learners' performance.

The Objectives of This Study

The research questions. The overall objective of this study was to answer the following research questions.

1. Does the presence of analogical pictures in a self-instructional program affect the learners' performance outcomes?
2. Does the learners' verbal ability affect the learning outcomes?
3. Does the learners' prior knowledge of the subject of instruction affect the learning outcomes?
4. Does the learners' learning style (strength of visual sensory modality for processing

information) affect the learning outcomes?

5. Does the learners' gender, culture, or age affect the learning outcome?

The specific learner attribute investigated in this ATI study was subjects' learning style (in terms of strength of visual sensory modality preference). The treatment conditions were defined by the absence or presence of analogical pictures in text-based, self-instructional, print materials. The targetted performance outcome was the subjects' acquisition of knowledge about and comprehension of a five stage model of the planning process. Using adult students recruited from three different post-secondary institutions in Northern Alberta, this study contributes to the existing body of research by: a) extending Paivio's research on the interaction of "visual" learning style to performance outcomes at a higher level of cognitive functioning (Bloom's categories of intellectual skills and abilities); b) utilizing visual symbol systems on the non-notational end of Goodman's continuum to teach higher level concepts; c) incorporating the instructional technique of visual analogical reasoning; and d) using a subject population that is under-represented in the research literature. The research findings add to instructional designers' understanding of how analogical visuals in text-based, self-instructional materials interact with adult learners' ability and desire to utilize their visual sensory modality to learn abstract concepts.

Chapter III

RESEARCH METHODOLOGY

Hypotheses Tested

Hypothesis one. Given that analogical visuals appear to facilitate the learning of more abstract or higher level concepts (Alesandrini, 1984, 1985; Krueger, 1984; Mayer, 1985; Miller, 1984), then it is hypothesized that:

> instructional materials supplemented with relevant analogical pictures will produce higher performance outcomes in all subjects than will identical instructional materials not supplemented with relevant analogical pictures.

Hypothesis two. Given that learners who demonstrate a preference to use their visual sensory modality appear to learn more effectively from instruction that contains visual elements (Levie & Lentz, 1982; Paivio, 1986), and that learners who do not demonstrate this preference do not necessarily learn more effectively from instruction that contains visual elements (Kyllonen et al., 1984; Lohman, 1984; Taylor et al., 1987), then it is hypothesized that:

> instructional materials supplemented with relevant analogical pictures will produce higher performance outcomes in subjects demonstrating a more visually-oriented learning style (as measured by the Space Relations subtest of the Differential

Aptitude Test and the Imagery Scale of the
Individual Differences Questionnaire).

Research Design

The research design used in this experimental field study was a 2 treatment (instructional condition) by 2 level (high versus low visual learning style) factorial design. Once categorized by learning style (68 low visual subjects and 61 high visual subjects), subjects were randomly assigned to the two instructional conditions (text only or "T" and text plus analogical pictures or "TP"). The two instructional conditions contained almost equal numbers of subjects (65 subjects in the T condition and 64 subjects in the TP condition).

	INSTRUCTIONAL CONDITION	
	Text Only (T)	Text plus Analogical Pictures (TP)
LEARNING STYLE		
Low Visual	n=37	n=31
High Visual	n=28	n=33

Variables. The dependent variable in the study was the subjects' acquisition of planning concepts, as measured by a multiple-choice test and open-ended questionnaire.

The independent variables in the study were:

1. instructional conditions: text only (T) and text plus analogical pictures (TP); and

2. learning style or degree of ability in and preference to use the visual sensory modality: low visual (L) and high visual (H).

The covariates in the study were:

1. prior knowledge of the planning process; and
2. verbal reasoning ability.

Statistical Procedures

Analysis of covariance. Analysis of covariance, with subjects' prior knowledge of the planning process and verbal reasoning ability acting as the covariates, was used to test the hypotheses. These two variables have shown to be significant in previous research (Dwyer, 1987).

Item analysis. A computerized item analysis was performed on both the pilot and final multiple-choice test pre- and post- items (ITEMANAL, 1980). The item analysis method used was biserial correlation (Gulliksen, 1965), which measured the ability of each test item to discriminate between the low and high scoring subjects, as well as the difficulty level of each test item. The discrimination and difficulty levels of all final items used to test the hypotheses fell within recommended guidelines (Ferguson, 1981; Stanley & Hopkins, 1972).

Factor analysis. Two separate factor analyses were performed on the final multiple-choice test data. The first analysis used Fact20 (Division of Educational Research Services, 198?) to reveal the number of distinct factors that appeared to account for the multiple-choice test post-score data. The second analysis used LISREL (1986) to calculate how closely the multiple-choice test instrument came to measuring the five stage planning model that it was designed to assess.

Reliability. Cronbach's Alpha coefficients (Fact20) assessed the reliability of the two instruments (multiple-choice test and open-ended questionnaire) used in the study to measure the dependent variable, as well as the reliability of all pre-test data (Verbal Reasoning and Space Relations subtest scores, and Individual Differences Questionnaire Scale scores).

Inter-relationships. Pearson Product-Moment coefficients were calculated to explore for relationships amongst all variables, as well as the inter-rater reliability of the open-ended questionnaire scores, and the test-retest reliability of the multiple-choice post-test scores.

Significant differences. Independent groups t-tests were performed on all of the variables measured in the study by gender, learning style and culture, to explore for any significant differences on these variables on these individual learner characteristics.

All statistical procedures were performed on the University of Alberta mainframe computer using statistical programs developed commercially (LISREL, 1986; SPSS, 1988) or by the Department of Computing Services (ITEMANAL, 1980) or

Division of Educational Research Services (FACT20, 1989) at the University of Alberta.

Sample Selection

The subjects for the study were drawn from adult students enrolled in three different Northern Alberta, post-secondary institutions (designated A, B, and C). Subjects from institutions A (n=81) and B (n=17) were from intact classrooms of students attending full-time university or college preparation programs, while subjects from institution C (n=31) were solicited from full-time students attending senior high school level, academic up-grading classes. Complete pre-post data was collected on one hundred and twenty-nine of the original one hundred and sixty-five subjects who were pre-tested. Of the 36 subjects who were dropped from the study, 22 withdrew from their respective programs and 14 were absent from class at the time of post data collection.

Seventy-five of the subjects were female, and fifty-four were male. Subjects' average age was 30 years and 9 months and the average number of years of schooling they had attained before entering their present program was 10 1/2. Female subjects had significantly ($p<.05$) less schooling (8 months less) than did male subjects. Using the Differential Aptitude Test Grade 10 Spring norms (Bennett, Seashore & Wesman, 1982), the female subjects' verbal reasoning subtest scores placed them at the 60th percentile while the male subjects' scores placed them significantly higher ($p<.05$) at the 70th percentile. Female subjects' space relations subtest scores placed them at the 55th percentile, while their male counterparts were somewhat higher at the 60th percentile.

Data Collection

Data collection occurred during the Fall 1989 academic semester. All testing and instruction was done within regularly scheduled class times at institutions A and B, or specially scheduled meeting times at institution C. Data was collected in six separate subject groups as follows:

Group 1 (institution A)	n=18
Group 2 (institution A)	n=22
Group 3 (institution A)	n=23
Group 4 (institution A)	n=18
Group 5 (institution B)	n=17
Group 6 (institution C)	n=31

Group 1 consisted of an intact special classroom of Treaty Status Native subjects.

All tests were administered and scored by the researcher (with the exception of one pre-test group administration conducted by the Program Co-ordinator at institution A). As well, instructional material completion was supervised by the researcher, who answered questions related only to vocabulary or procedure clarification.

Prior to the first data collection session, the researcher described the overall objective of the study to the subjects as that of finding out more about the manner in which different students learn from various kinds of instructional methods. A full explanation of the study's specific objectives, individualized feedback on each subject's learning style, and a seminar on visually-oriented study techniques (such as, link mnemonics and mind-mapping) was delivered to all subjects within a month of post testing.

All of the pre-testing was conducted within the first six weeks of the subjects' first semester of their programs. The four pre-tests (Verbal Reasoning, Space Relations, Individual Differences Questionnaire, and Multiple-Choice Test) took about two hours to administer in two consecutive class periods (Groups 1,2,3, and 4) or one two-hour session (Groups 5 and 6).

The post-testing was conducted immediately after the subjects completed the instructional materials, within one scheduled class period, and approximately four weeks after the pre-testing. Completion of the instructional booklets took an average of 30 minutes, while the post-testing (Multiple-Choice Test, Open-ended Questionnaire) took about 30 minutes altogether.

Development of the Instructional Materials

The instructional materials consisted of the instructional booklet and measures of the dependent variable.

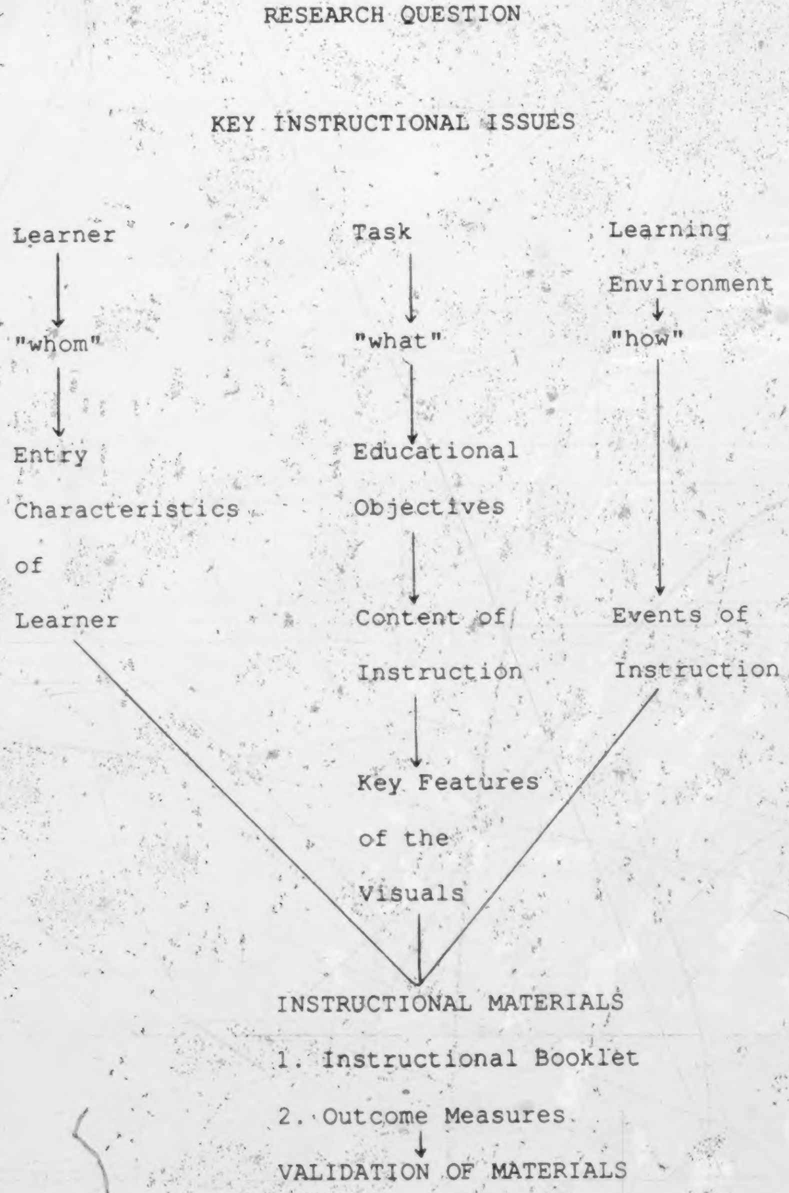
Two versions of the instructional booklet made up the two instructional conditions in the study: the "text-only" or "T" version, and the "text plus analogical pictures" or "TP" version. Subjects' acquisition of the planning concepts was assessed at two different levels of complexity: a) knowledge of the concepts, measured by the open-ended questionnaire, and b) comprehension of the concepts, measured by the multiple-choice test.

Development of the instructional booklets. The instructional booklets were developed in a four step process: a) analysis of the instructional issues, b) development of the text element, c) development of the visual element, and d) validation of the final versions of the instructional booklets.

Analysis of the instructional issues began with a clear description of the three main components of instruction (learner, learning task, and the learning environment) in terms of the study's research questions (see Figure 1). The key learner variables defined for this study were: a) attitude or motivation to learn the content of instruction (assumed by learners' presence in the program), b) prior knowledge of the content of instruction, c) learning style, d) reading level, and e) verbal ability. The key learning task variable defined for this study was the level of complexity of the concepts that would form the content of the instructional booklet. The concepts were established to be

Figure 1

Development of the Instructional Materials


RESEARCH QUESTION
KEY INSTRUCTIONAL ISSUES
Learner
"whom"
Entry Characteristics of Learner
Task
"what"
Educational Objectives
Content of Instruction
Key Features of the Visuals
Learning Environment
"how"
Events of Instruction
INSTRUCTIONAL MATERIALS
1. Instructional Booklet
2. Outcome Measures
VALIDATION OF MATERIALS

at levels 1 (knowledge) and 2 (comprehension) of Bloom's taxonomy of educational objectives, using Bloom's (1956) criteria (see Appendix B). The key learning environment variables defined for this study were: a) the form that the instruction would take (text-based, self-instructional), and b) instructional techniques in the booklets.

At various points in the development process, content experts were consulted about the accuracy and appropriateness of all three main components of instruction. In order to establish the content validity of the final versions of the instructional booklets, five content experts (senior instructors at institutions A and C) were asked to independently rate each section of the text and the corresponding picture against the educational objective that it was designed to achieve. The text was rated by the content experts as meeting the objectives completely 92% of the time, and meeting the objectives quite well (75 to 100%) the other 8% of the time. The pictures were rated as meeting the objectives completely 66% of the time, and as meeting the objectives quite well 44% of the time. Overall, the text and pictures were rated by content experts as meeting the five stated educational objectives of instruction at least 75% of the time, with most of the text and pictures meeting these objectives 100% of the time.

Development of the text element of the instructional booklet. Figure 2 outlines the steps involved in the development of the text element of the instructional booklet. The instructional design model used was a competency-based system of occupational analysis called Life Role Analysis (see Appendix A). Using this model, the content of instruction was derived from an interview with a career planning content expert. The resulting competency profile and accompanying instructional design template, validated by two other career planning, content experts, was subsequently used as the conceptual framework for the text element of the instructional booklet. The design template outlines the educational objectives, content of instruction (or capabilities), type of capability (or learning outcome), and instructional technique used to assist the learner to acquire each capability.

The overall educational objective of the instructional booklet was to teach learners a generic, five stage, planning model that they could then use to implement a personal career goal (formulated by the end of the academic semester). The planning model used was sequential, with the final, fifth stage introducing the concept of looping back to previous stages as a strategy for revising an unworkable plan. At the end of the instruction, learners were expected to have acquired a knowledge of the principles of the planning process, and comprehension of how each of the five stages

Figure 2

Development of the Text Element of the Instructional Booklet

LIFE ROLE ANALYSIS

1. content expert
2. competency profile
3. instructional template

↓

Educational Objectives

(Appendix B)

1. Main concepts
2. Supplementary concepts

↓

Key Instructional Techniques:

1. Behavioural Objectives
2. Advanced Organizers
3. Inserted Questions
4. Underline Key Words
5. Use of Examples
6. Use of Analogy

↓

Gagne's Nine Events of Instruction

(Appendix D)

contribute to an overall, workable plan.

The six instructional techniques used were: a) behavioural objectives, specified for the learner at the beginning of each section in the booklet, b) advanced organizers, outlined in the first section of the booklet, c) inserted questions with informational feedback, at the end of each section of the booklet, d) underlined key words/phrases, that were subsequently tested in the true/false questions at the end of each section, e) examples of good and poor applications of the principles, to assist the learner to discriminate the key stimulus features of the concepts being taught, and f) the use of analogy (verbal and visual), to assist the learner to acquire the unfamiliar abstract concepts of planning by linking them to familiar parallel concepts related to the process of travelling by car from an origin to a destination.

The completed 4,000 word text (see Appendix A) was written at a grade eight reading level, as measured by the Fry Readability scale (1978), and pilot tested with ten adult students closely resembling the subject group in general ability and reading level. Modifications were made to the text as a result of the students' feedback.

Development of the visual element of the instructional booklet. Four key visual design issues were considered in the development of the pictures that accompanied the text element (see Figure 3). These were: a) use of realistic

Figure 3

Development of the Visual Element of the Instructional Booklet

↓

TEXT ELEMENT

KEY VISUAL DESIGN ISSUES

1. realistic pictograms
2. line drawings
3. placement
4. perception & communication principles

↓

Goldsmith's Analytical Model

(Appendix E)

Communication Factors:

		Syntactic	Semantic	Pragmatic
Visual Factors:	Unity	1	2	3
	Location	4	5	6
	Emphasis	7	8	9
	Text Parallels	10	11	12

↓

Creation of Pictures

↓

INTEGRATION WITH TEXT

pictograms, to reduce the chance of learner misunderstanding (Goldsmith, 1984; Hodgson, 1985); b) use of line-drawings, as lower reading level subjects tend to learn better from less complex visuals (Dwyer, 1987); c) placement of the picture on the upper left-hand part of the page, as neurophysiological studies indicate that this may be the optimal viewing area (Hart, 1984); and d) the use of guidelines arising from research in perception and communication (Goldsmith, 1984).

Goldsmith (1984) developed a set of guidelines for analyzing the comprehensibility of illustrations intended to be supportive to educational text that incorporates both Goodman's criteria for notationality and the individual learner characteristic of visual literacy. Goldsmith's analytical model consists of twelve elements which are formed by the interaction of four visual and three communication factors. The visual factors are unity (within a single image), location (spatial relationships between two or more images within a single picture), emphasis (hierarchical relationships between images), and text parallels (relationship between text and picture). The three levels of communication are syntactic (does not assume any recognition of images), semantic (concerns the basic recognition of an image), and pragmatic (deals with what the viewer brings to the situation). The twelve elements are:

1. syntactic unity - refers to the importance of boundaries between images, implying that images

should be clearly discernable.

2. semantic unity - refers to the identifiability of single images, implying that there should be sufficient features in an image to allow the viewer to recognize it.
3. pragmatic unity - refers to the characteristics of viewers that affect their ability to recognize an image (familiarity of object to viewer, viewer's level of interpretation, context of image, implied motion, sequencing of images).
4. syntactic location - refers to depth perception in particular, which can be affected by texture gradients, figural elevation and overlap, converging lines, shading.
5. semantic location - refers to the image's recognizability, which can be affected by the relationship of the image's size with its surroundings.
6. pragmatic location - refers to the affect that the development level and experience of the viewer has on the resolution of ambiguous images.
7. syntactic emphasis - refers to how the image attracts and directs the attention of the viewer (colour, position, size, isolation, complexity, tonal contrast, directionality, implied motion).

8. semantic emphasis - refers to the presence and placement of a human figure in a picture, as a way of directing the viewer's attention.

9. pragmatic emphasis - refers to the tendency of the viewer to view in a particular way; from top to bottom of image and from left to right.

10. syntactic text parallels - refers to the spatial and temporal relationship between the text and picture. Temporally, the channel that contains the main instruction should be presented first. If both channels contain the same instruction, the visual presented before the verbal appears to enhance concept retention (Gropper, 1966).

11. semantic text parallels - refers to the matching of text and image by verbal labels, which should be as exact as possible.

12. pragmatic text parallels - refers to the interpretation tendencies of the viewer (influenced primarily by pictorial literacy and cultural factors).

The pictures were conceptualized by the researcher (in consultation with content experts) and drawn by a professional graphic artist. Appendix E describes how each of the pictures conforms to Goldsmith's twelve elements.

Development of the multiple-choice test. The pilot draft of the test consisted of 60 multiple-choice questions, twelve for each stage of the five stage planning model described in the instructional materials. These questions were based on the five educational objectives which had been derived from the Life Role Analysis done at the beginning stages of the instructional design process. A computerized item analysis (ITEMANAL, 1980) was conducted on each of these 60 items after the test was administered to 84 adult summer students from institution A. The thirty best items (with difficulty levels of between .30 and .70, and discriminating power of at least .30) were retained. In order to establish the content validity of the 30 item test, two career planning content experts independently rated each question against the planning concept that it was designed to address. Twenty-seven questions were given a 100% question-concept fit, and the remaining three a 75% question-concept fit. Cronbach's Alpha for the 30 item multiple-choice test (see Appendix F) was calculated as .55 on the post-test scores for all 129 subjects.

As this coefficient indicated a lower than desirable level of internal consistency, test-retest reliability was checked (Pearson Product-Moment coefficient=.71) by administering it a third time to 39 subjects from institution A, five weeks after the post-testing session. Then, an examination of the subjects' response patterns was conducted by first factor analysing the post-scores and then looking for abnormalities in response patterns across different subject groupings.

i) Factor analysis of the post-scores. A principal components factor analysis (varimax rotation) of the post-scores indicated that while the multiple-choice test appeared to be measuring up to five unrelated factors (with eigenvalues above 1.55), these factors were not clearly interpretable in terms of the five stage planning model described in the instructional materials. A Least Squares solution (LISREL, 1986) lent some support for the five stage model, but indicated that overall, the multiple-choice test did not appear to be measuring the model very closely for the 129 subjects tested (Goodness of fit index was .83, $p<.04$).

ii) Grouping subjects by response pattern. Pre- and post- test Cronbach Alpha coefficients calculated separately on the six subject groups indicated that the multiple-choice test was more reliably measuring the outcome performance for subject groups 1,2,5, and 6, than for groups 3,4, and to some extent group 5. Groups 3 and 4, in particular, appeared to be responding to the post administration of the multiple-choice test in a haphazard fashion, perhaps indicating a lack of motivation to attend seriously to this complex task.

Cronbach Alpha Coefficients

Group 1	pre: .34	post: .49
Group 2	pre: .50	post: .62
Group 3	pre: .46	post: .39
Group 4	pre: .45	post:-.07

Group 5 pre: .79 post: .66

Group 6 pre: .65 post: .66

Two factors could have contributed to the possibility that some subjects not taking the post-test as seriously as others: a) the fact that they were not receiving academic credit for their participation in the study, and b) that post-testing took place in the week prior to mid-term exams.

As a consequence, the discussion of data analysis results in the next chapter explains and compares these groupings:

All Groups (n=129) Post-Test Alpha: .59

Groups 2,5,6(n=70) Post-Test Alpha: .67

An item analysis conducted on the multiple-choice test post scores indicated that item #1 was unacceptable in terms of both difficulty level and discriminating power. This item was therefore deleted from the data analysis.

Development of the open-ended questionnaire. The second measure consisted of six, open-ended questions that required the subjects to recall and describe the five stage planning model outlined in the instructional materials (see Appendix G). In order to establish the scoring reliablity of this measure, 65 completed questionnaires were randomly selected for independent scoring by two raters, in addition to the researcher. There were no significant differences in the three separate ratings and the Pearson Product-Moment coefficients between raters 1 and 2 (two independent raters) and 3 (the researcher) were .81 and .85 (Winer, 1962).

Cronbach Alpha coefficients calculated for the various subject groupings revealed differences in the response patterns on this instrument also:

All Groups	(n=127)	Alpha: .79
Groups 2,5,6	(n=68)	Alpha: .76

Overall, the open-ended questionnaire appeared to be reliably measuring the subjects' recall of the key planning concepts.

Measure of Learning Style

Each subject's learning style was determined by their combined scores on the Space Relations subtest of the D.A.T., and a short version of the Individual Differences Questionnnaire (I.D.Q.).

The Space Relations subtest is a timed test (25 minutes) that measures one's ability to deal with concrete materials through visualization, requiring the mental manipulation of objects in three-dimensional space. The split-half reliability coefficient for this subtest is .93 for both males and females at the grade ten level. It correlates moderately well with the American College Test composite score at the grade twelve level (.73 for males and .55 for females) and the Otis-Lenon Mental Ability Test at the grade ten level (.50 for females and .54 for males).

The short version of the I.D.Q. (Hiscock, 1978) is an untimed self-report instrument that contains 72 items designed to measure six aspects of imaginal and verbal thinking:

1. good verbal expression and fluency;
2. habitual use of imagery;
3. concern with correct use of words;
4. self-reported reading difficulties;
5. use of images to solve problems; and
6. vividness of dreams, daydreams and imagination.

The I.D.Q. provides a two category assessment of imagery/verbal information processing preference and takes about fifteen minutes to complete. According to Paivio (1986), the typical distribution of visually- versus verbally- oriented preferences for processing information in the general population is about one-third high visual, one-third high verbal and one-third mixed. Paivio's research indicates that the two scales of the I.D.Q. (imagery and verbal) are not correlated, so that a high score on one does not necessarily mean a low score on the other. Research with this instrument has revealed gender differences on the Imagery Scale, with females reporting better imagery than males (Hiscock, 1978; Harshman and Paivio, 1987). This finding appears to be paradoxical, as gender differences on objective measures of spatial ability tend to be in the opposite direction (Maccoby & Jacklin, 1974).

The original 86 item version of the I.D.Q. was developed from the perspective of dual coding theory (Paivio, 1971) and has been used by researchers to categorize subjects according to the degree to which they utilize a visual and/or verbal information processing style (Richardson, 1977; Paivio, 1983). Hiscock (1978) created the shorter and more reliable version used in this study. The test has reliability coefficients of .80 for the Imagery and .83 for the Verbal scales. As this instrument was developed on undergraduate university subjects, the researcher asked a small group (n=10) of students from institution A to evaluate its vocabulary level. As a result, a few wording changes were made to lower the instrument's reading level (see Appendix H).

Reviews of visual learning as a cognitive style indicate that this style consists of two unrelated aspects of an individual's information processing behaviour: a) an ability to use mental imagery , and b) a propensity to use this ability (DiVesta, Ingersoll & Sunshine, 1971; Ernest, 1977; Richardson, 1977; Katz, 1983). Therefore, in this study, a subjects' learning style was categorized as either high (H) or low (L) visual according to their combined Space Relations and Imagery Scale I.D.Q. scores. Total scores from the Space Relations and Imagery Scale were converted to standard scores and then summed for each subject. Subjects with positive combined standard scores were categorized as high visual (n=61), and subjects with negative combined standard scores were categorized as low visual (n=68) (Ernest & Paivio, 1971a, 1971b). The mean high visual subject total standard score was 1.38 (SD=.98) and the mean low visual subject standard score was -1.24 (SD=.92). The 75 female subjects had significantly lower ($p<.05$) mean standard scores (-.27; SD=1.51) than did the 54 male subjects (.37; SD=1.69), which resulted in their disproportionate representation in the low visual subject category group (45 females to 23 males). Females and males are equally represented in the high, visual subject group (30 females and 31 males).

Table 1 shows the unequal length Spearman-Brown reliability coefficients for subjects' Space Relations subtest scores and Cronbach's Alpha reliability coefficients for subjects' I.D.Q. Scale scores. These coefficients are very close to the Spearman-Brown reliability coefficients reported in the D.A.T. manual and the Cronbach's Alpha coefficients for the I.D.Q Scales reported by Hiscock (1978).

Other Data Collected

Prior knowledge of the planning process. The subject's prior knowledge of the planning process was measured in the pre-testing session with the same multiple-choice test used as the performance outcome measure.

Verbal reasoning ability. Subjects' verbal reasoning ability was measured by the Verbal Reasoning subtest of the Differential Aptitude Test. The Verbal Reasoning subtest is a timed test (30 minutes) that measures the ability to understand concepts framed in words, to abstract or generalize and to think constructively. Split-half reliability coefficients for the Verbal Reasoning subtest are .93 for both sexes at the grade 10 level. This subtest correlates substantially for both sexes with several general ability measures: Otis-Lenon School Mental Ability Test at the grade ten level (.78 for females and .83 for males); American College Test composite score at the grade 12 level (.84 for males and .81 for females) and the Verbal subtest of the Scholastic Aptitude Test at the grade 11 level (.81 for males and .73 for females). Table 1 shows the reliability coefficients for subject's' Verbal Reasoning subtest scores.

Demographic data. During the pre-testing session, subjects supplied information about their gender, years spent in school prior to entering their program, and current age.

Table 1

Reliability Coefficients For Subjects' Verbal Reasoning, Space Relations Subtest Scores and I.D.Q. Verbal and Imagery Scale Scores (n=129)

	RELIABILITY COEFFICIENT		
	FEMALES n=75	MALES n=54	TOTAL n=129
SUBTEST:			
VERBAL REASONING	.89	.84	.88
SPACE RELATIONS	.96	.95	.96
I.D.Q. VERBAL	.88	.86	.87
I.D.Q. IMAGERY	.86	.88	.87

Chapter IV

RESULTS

Overview of the Study

This study was designed to investigate the relative effectiveness of two instructional conditions designed to teach higher order concepts to adult subjects who differ in the degree to which they are able and prefer to use their visual sensory modality to learn. One instructional condition (Text Only or T) consisted of a 15 page self-instructional booklet. The other condition (Text Plus Analogical Picture or TP) consisted of an 18 page self-instructional booklet, with the identical text element as the T condition, plus six pictures constructed to visually depict the verbal analogy utilized as the main instructional technique.

The subjects' learning style was categorized as high (H) or low (L) visual according to their totalled standard scores on an equally weighted objective measure of spatial ability (Space Relations subtest of the D.A.T.), and subjective measure of visual sensory modality preference (Individual Differences Questionnaire Imagery Scale).

The relative effectiveness of each instructional condition was assessed by the subjects' acquisition of planning knowledge, as measured by two instruments: a multiple-choice test (designed to assess comprehension of the planning concepts) and an open-ended questionnaire (designed to assess knowledge of the planning concepts).

The dependent variables were analyzed using analysis of covariance, with prior knowledge of planning (as measured by the multiple-choice test pre-scores) and verbal ability (as measured by the Verbal Reasoning subtest of the D.A.T.) utilized as the covariates.

Pearson Product-Moment correlation coefficients were calculated (see Tables 2, 3, 4, and 5) for all nine variables (multiple-choice test pre- and post- scores, open-ended questionnaire scores, Verbal Reasoning and Space Relations subtest scores, I.D.Q. Imagery and Verbal Scale scores, gender, educational background and age) for all subjects, for Native versus non-Native subjects, for high versus low visual subjects, and for female versus male subjects. Only significant ($p<.05$) correlation coefficients are reported.

Due to some differences in the response patterns and reliability coefficients obtained for some subject groupings, the analysis of each dependent variable is discussed in terms of these subject groupings: a) all groups (n=129), b) groups 2,3,4,5 and 6 (n=111), c) groups 2,5, and 6 (n=70), and d) group 1 (n=18). Groups 2 through 6 consisted of all non-Native subjects, groups 2,5 and 6 exhibited the highest reliability on the multiple-choice test, and group 1 consisted of all Native subjects. Unless otherwise indicated, all significance levels reported are $p<.05$.

Table 2

Summary of Significant Pearson Product-Moment Coefficients for All Subjects
(n=129) & Subject Groups 2,5&6 (n=70)

VARIABLE		Post	Qu.	VR	SR	Imag.	Verb.	Sex	Grade	Age
Pre	All	.63	.18	.56	.36	.25	.17	–	.33	.16
	2,5,6	.63	–	.67	.31	.22	.31	–	.36	–
Post	All		.42	.46	.33	.17	–	–	.16	.23
	2,5,6		.49	.54	.32	–	.26	–	–	–
Qu.*	All			–	.24	–	–	.17	–	.40
	2,5,6				.40	–	–	–	.23	–
VR	All				.48	.16	.27	.20	.36	–
	2,5,6				.50	–	.28	.28	.28	–
SR	All					.30	–	.22	.35	.29
	2,5,6					.28	–	.24	.30	–
Imag.*	All						.23	-.18	–	–
	2,5,6						.35	–	–	–
Verb.*	All							-.14	–	–
	2,5,6							–	–	–
Sex	All								.18	.23
	2,5,6								.22	–
Grade	All									.19
	2,5,6									.25

$p < .05$
*Imag. = I.D.Q. Imagery Scale
Verb. = I.D.Q. Verbal Scale
Qu.= Open-ended Questionnaire

Table 3

Summary of Significant Pearson Product-Moment Coefficients for Native (n=18) and Non-Native (n=111) Subjects

VARIABLE.		Post	Qu.	VR	SR	Imag.	Verb.	Sex	Grade	Age
Pre	Native	.57	.55	–	–	.57	–	–	–	–
	Non-Native	.61	–	.59	.32	.19	.21	–	.30	–
Post	Native		.45	–	–	–	–	–	–	–
	Non-Native		.39	.48	.32	–	.15	–	.19	.19
Qu.	Native			–	.40	–	–	–	–	.61
	Non-Native			–	.16	–	–	–	–	.30
VR	Native				–	–	–	–	.59	–
	Non-Native				.48	–	.26	.27	.32	–
SR	Native					.43	–	-.50	–	–
	Non-Native					.26	–	–	.34	.24
Imag.	Native						–	–	–	.48
	Non-Native						.29	–	.16	–
Verb.	Native							–	–	–
	Non-Native							–	–	–
Sex	Native								–	–
	Non-Native								–	–
Grade	Native									–
	Non-Native									.23

p<.05
Imag. = I.D.Q. Imagery Scale
Verb. = I.D.Q. Verbal Scale
Qu.= Open-ended Questionnaire

Table 4

Summary of Significant Pearson Product-Moment Coefficients for Male (n=54) and Female (n=75) Subjects

VARIABLE		Post	Qu.	VR	SR	Imag.	Verb.	Grade	Age
Pre	Male	.57	–	.42	.38	.34	–	.31	–
	Female	.65	.20	.61	.33	.19	.22	.32	–
Post	Male		.33	.34	.35	.30	–	–	–
	Female		.45	.50	.29	–	–	.24	–
Qu.	Male			–	.31	–	–	–	.34
	Female			–	–	–	–	–	.25
VR	Male				.39	–	.32	.36	–
	Female				.52	–	.27	.34	–
SR	Male					.27	–	.40	.42
	Female					.31	–	.24	–
Imag.	Male						.22	–	–
	Female						.25	–	–
Verb.	Male							–	–
	Female							–	–
Grade	Male								–
	Female								.21

$p < .05$
Imag. = I.D.Q. Imagery Scale
Verb. = I.D.Q. Verbal Scale
Qu.= Open-ended Questionnaire

Table 5

Summary of Significant Pearson Product-Moment Coefficients for Low (n=68) and High (n=61) Visual Subjects

VARIABLE		Post	Qu.	VR	SR	Imag.	Verb.	Grade	Age
Pre	Low	.68	.26	.50	.22	.21	–	.20	–
	High	.46	–	.53	–	–	.24	.35	–
Post	Low		.31	.47	.25	–	–	–	–
	High		.54	.31	–	–	–	–	–
Qu.	Low			–	.30	–	–	–	.31
	High			–	–	–	–	–	.26
VR	Low				.37	–	.19	.36	–
	High				.40	–	.31	–	-.23
SR	Low					-.25	–	–	.21
	High					–	–	.28	–
Imag.	Low						.35	–	–
	High						–	–	–
Verb.	Low							.27	–
	High							–	–
Grade	Low								–
	High								.22

$p<.05$
Imag. = I.D.Q. Imagery Scale
Verb. = I.D.Q. Verbal Scale
Qu.= Open-ended Questionnaire

Description of the Data

Subject's learning style. Table 6 shows a summary of observed means and standard deviations of the Space Relations subtest scores and the I.D.Q. Imagery Scale scores. There were differences between the scores of Native and subjects' in general on the two instruments that determined learning style category. The Native subjects scored lower on both of these measures than did subjects' in general. As well, male Native subjects' mean Space Relations subtest scores (15.50; SD=9.29) were considerably lower than those of the female Native subjects' Space Relations subtest scores (29.21; SD=10.84). The reverse is true of the male (36.15; SD=12.44) and female (30.99; SD=10.06) Space Relations mean scores of subjects' in general. As a result, Native subjects' were disproportionately represented in the low visual group (11 of the 18 Native and 3 of the 4 Native males are in the low visual group). The average totalled standard scores (Space Relations and Imagery Scale) were -.26 (SD=1.51) for female and .37 (SD=1.69) for male subjects' in general; while it was -.68 (SD=1.55) for Native females and -1.83 (SD=1.95) for Native males.

In comparison, female undergraduate mean scores on the Imagery Scale were 134.99 (SD=11.91), and male undergraduate mean scores were 126.02 (SD=14.23) (Hiscock, 1978).

Subject's verbal reasoning ability. Table 7 shows a summary of observed means and standard deviations of the

Table 6

Summary of Observed Means and Standard Deviations of Space Relations & I.D.Q. Imagery Scale Scores by Gender & Culture

All Subjects

	Female (n=75)		Male (n=54)		Total (n=1 9)	
	SR	Imag.*	SR	Imag.	SR	Imag.
MN	30.99	123.64	36.13	126.17	33.14	124.70
SD	10.06	13.74	12.44	14.42	11.36	14.03

Native Subjects

	Female (n=14)		Male (n=4)		Total (n=18)	
	SR	Imag.	SR	Imag.	SR	Imag.
MN	29.21	120.00	15.50	120.75	26.17	120.17
SD	10.84	11.24	9.29	20.07	11.81	12.95

$p < .05$

*Imag.=Imagery

Table 7

Summary of Observed Means and Standard Deviations of Verbal Reasoning Subtest Scores by Gender and Culture

All Subjects

	Female (n=75)	Male (n=54)	Total (n=129)
MN*	28.23	32.19	29.88
SD	10.39	7.89	9.62

Native Subjects

	Female (n=14)	Male (n=4)	Total (n=18)
MN	25.79	29.00	26.50
SD	8.20	12.68	9.04

* $t(1,127)=1.69$, $p<.05$

Verbal Reasoning subtest by gender and culture. Male subjects in general achieved significantly higher Verbal Reasoning scores (t=1.69, p<.05) than did female subjects in general. Native subjects of both genders scored lower than did the female and male subjects considered as a whole. In addition, an independent groups t-test revealed that high visual subjects achieved significantly higher (t=3.73, p<.001) mean Verbal Reasoning scores (33.03; SD=8.03) than did low visual subjects (27.06; SD=10.11).

Subject's prior knowledge of the planning process. Table 8 shows a summary of the observed means and standard deviations of the multiple-choice test pre-scores by gender and culture. Overall, females' and males' post- scores on this measure were equivalent. Native subjects of both genders, on the other hand, tended to score lower (t=-4.42, p<.001) than did the total subject group on this measure of prior knowledge; with Native males scoring signficantly higher (t=4.50, p<.05) than did Native females. This result is probably due to the higher variance in the smaller male sample, rather than any real differences in prior knowledge. It appears that the Native subjects came into the experimental situation with generally less prior knowledge of the subject content of the instructional materials than did their non-Native counterparts.

Table 9 shows the mean observed multiple-choice test pre- scores obtained by each of the four experimental groups.

Table 8

Summary of Observed Means and Standard Deviations of Multiple Choice Test Pre-Scores by Gender and Culture

All Subjects	Female	Male	Total
	(n=75)	(n=54)	(n=129)
MN	15.21	16.41	15.71
SD	4.58	3.79	4.29

Native Subjects	Female	Male	Total
	(n=14)	(n=4)	(n=18)
MN*	11.86	11.75	11.83
SD	2.48	5.25	3.09

* $\underline{t}(1,16)=4.5$, $\underline{p}<.05$

Table 9

Summary of Observed Means of Multiple-Choice Test Pre-Scores (n=129)

	INSTRUCTIONAL CONDITION		
	Text Only T	Text plus Analogical Pictures TP	Row Total
LEARNING STYLE			
Low Visual	14.30 n=37	14.39 n=31	14.34 n=68
High Visual	17.50 n=28	17.03 n=33	17.25 n=61
Column Total	16.77 n=65	16.71 n=64	16.74 n=129

The mean multiple-choice test pre-score for all subjects was 15.71 (SD=4.29), while the mean multiple-choice test post-score was 17.77 (SD=3.80). H visual subjects obtained significantly ($t=-4.10$, $p<.001$) higher pre-test scores than did the L visual subjects.

Performance outcomes. Independent groups t-tests were used to test for significant differences between mean performance outcome scores. Table 10 shows the mean observed scores obtained by each of the four experimental groups in the post-testing session (L visual subjects in the T condition, L visual subjects on the TP condition, H visual subjects in the T condition, and H visual subjects in the TP condition) for each of the two performance outcome measures. Comparing across both instructional conditions, H visual subjects obtained significantly ($t=-3.07, p<.05$) higher performance outcome scores than did L visual subjects on the multiple-choice test. In terms of the open-ended questionnaire, while the differences between the L and H visual subjects were not significant, the H visual subjects in the T instructional conditions obtained the highest scores. Overall, L visual subjects in the T condition obtained the lowest scores on the multiple-choice test, and equivalent scores on the open-ended questionnaire in either instructional condition.

Table 10

Summary of Observed Means of Multiple-Choice Test Post-Scores and Open-ended Questionnaire (n=129)

		INSTRUCTIONAL CONDITION		
		Text Only T	Text plus Analogical Pictures TP	Row Total
LEARNING STYLE				
Low	MCT*MN	17.11	16.48	16.82
	Qu.*MN	8.82	9.48	9.12
High	MCT MN	18.86	18.79	18.82
	Qu. MN	10.11	9.53	9.80
Column Total	MCT MN	17.86	17.67	17.77
	Qu. MN	9.37	9.51	9.44

* MCT=Multiple-Choice Test

Qu.=Open-ended Questionnaire

Summary of Data Analysis

Hypothesis one: Instructional materials supplemented with relevant analogical pictures will produce higher performance outcome scores in all subjects than will identical instructional materials not supplemented with relevant analogical pictures.

ii) Multiple-choice test. Table 11 shows the summary of the analysis of covariance on the multiple-choice test post-scores for all subjects (n=129). A test of homogeneous slopes revealed that none of the slopes of the four experimental groups were significantly different (UANOVA, in SPSS, 1988). Once the effects of the two covariates (Verbal Reasoning subtest and multiple-choice test pre-scores) is removed, there are no main effects for either subject learning style (Style) or instructional condition (Instruct.).

Subjects' pre-test scores (the second covariate listed on Table 12) account for a significant amount (F=41.33, p<.001) of the variance, while their Verbal Reasoning subtest scores (in the context of the pre-score), did not make a significant contribution to the variance.

The summary of the analysis of covariance on the multiple-choice test for subject groups 2,5, and 6 (n=70) is shown in Table 12. No main effects for either independent variable was found.

Table 11

Summary of Analysis of Covariance of Multiple-Choice Test Post- Scores (n=129)

Source	df	MS	F
Covariates	2	378.48	42.84*
VR+	1	31.08	3.52
Pre-Score	1	365.10	41.33*
Main Effects	2	2.38	.27
Style	1	2.55	.29
Instruct.	1	2.61	.30
2-Way Interaction	1	2.62	.30
Between Subjects	5	152.87	17.30*
Within Subjects	123	8.84	

*$p < .001$

+VR=Verbal Reasoning

Table 12

Summary of Analysis of Covariance of Multiple-Choice Test Post- Scores (n=70)

Source	df	MS	F
Covariates	2	261.03	24.99*
VR+	1	30.97	2.97
Pre-Score	1	163.34	15.64*
Main Effects	2	9.86	.94
Style	1	2.67	.26
Instruct.	1	16.94	1.62
2-Way Interaction	1	11.01	1.05
Between Subjects	5	110.56	10.58*
Within Subjects	64	10.45	

*p<.001

+VR=Verbal Reasoning

ii) Open-ended questionnaire. Table 13 shows the summary of the analysis of covariance on the open-ended aire for all subjects (n=127, two subjects did not complete this measure). Once the effect of the two covariates is removed there are no main effects for either independent variable. Table 14 shows the summary of the analysis of covariance of the open-ended questionnaire for subject groups 2,5, and 6 (n=68). The overall trend in the data is the same as that demonstrated on the total subject grouping, with no main effects found for either independent variable.

In summary, no main effects were demonstrated for either independent variable on the two performance outcome measures. When the effect of the two covariates (verbal ability and prior knowledge) was removed, neither subject learning style nor the instructional condition contributed significantly to the subjects' performance outcome scores. While subjects achieved overall significant gains from pre- to post-testing, L visual subjects achieved significantly more than did H visual subjects; therefore, it was the subjects' learning style, rather than the instructional condition, that accounted for this main effect. Hypothesis one, therefore, was not supported.

Hypothesis two: Instructional materials supplemented with relevant analogical pictures will produce higher performance outcome scores in subjects demonstrating a more visually-oriented learning style (as measured by the Space

Table 13

Summary of Analysis of Covariance of Open-Ended Questionnaire (n=127)

Source	df	MS	F
Covariates	2	22.32	2.18
VR+	1	.64	.06
Pre-Score	1	35.22	3.44
Main Effects	2	1.80	.18
Style	1	3.08	.30
Instruct.	1	.35	.03
2-Way Interaction	1	9.79	.96
Between Subjects	5	11.60	1.13
Within Subjects	121	10.25	

$p < .05$

+VR=Verbal Reasoning

Table 14

Summary of Analysis of Covariance of Open-ended Questionnaire (n=68)

Source	df	MS	F
Covariates	2	9.26	.97
VR+	1	.33	.04
Pre-Score	1	12.72	1.34
Main Effects	2	2.97	.31
Style	1	.90	.10
Instruct.	1	5.17	.54
2-Way Interaction	1	6.37	.67
Between Subjects	5	6.17	.65
Within Subjects	62	9.52	

$p<.05$

+VR=Verbal Reasoning

Relations subtest of the Differential Aptitude Test and the Imagery Scale of the Individual Differences Questionnaire).

i) Multiple-choice test. An examination of the analysis of covariance Tables 11 and 12, indicates that there were no interaction effects for either independent variable on this performance outcome measure for these subject groupings.

ii) Open-ended questionnaire. An examination of the analysis of covariance Tables 13 and 14, indicates that there are no interaction effects for either independent variable on this performance outcome measure for any of the subject groupings.

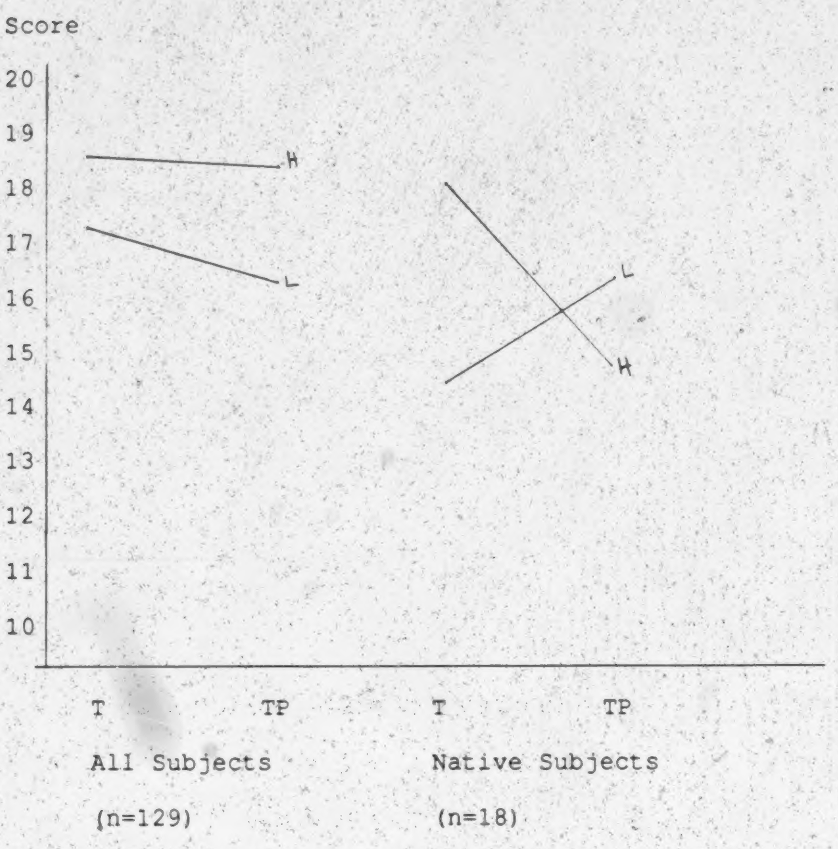
Overall, no support for Hypothesis two was demonstrated for the total subject group. Therefore, Hypothesis two was not supported.

Other Findings

Culture. While an analysis of the effect of culture was not part of the hypotheses, performance outcome pattern differences by culture became apparent (see Figures 4 and 5). While the Native subjects' scores were generally lower than their non-Native counterparts, they also achieved significant gains across both instructional conditions from pre- to post-testing on the multiple-choice test. Their pattern of scores was exactly opposite to that expected, and opposite to that of the non-Native subjects. On the other hand, the pattern of Native subjects' scores on the opened-ended questionnaire was the same as that of their non-Native counterparts, but

Figure 4

Observed Means of Multiple-Choice Test Post- Scores for all Subjects (n=129) and Native Subjects (n=18)

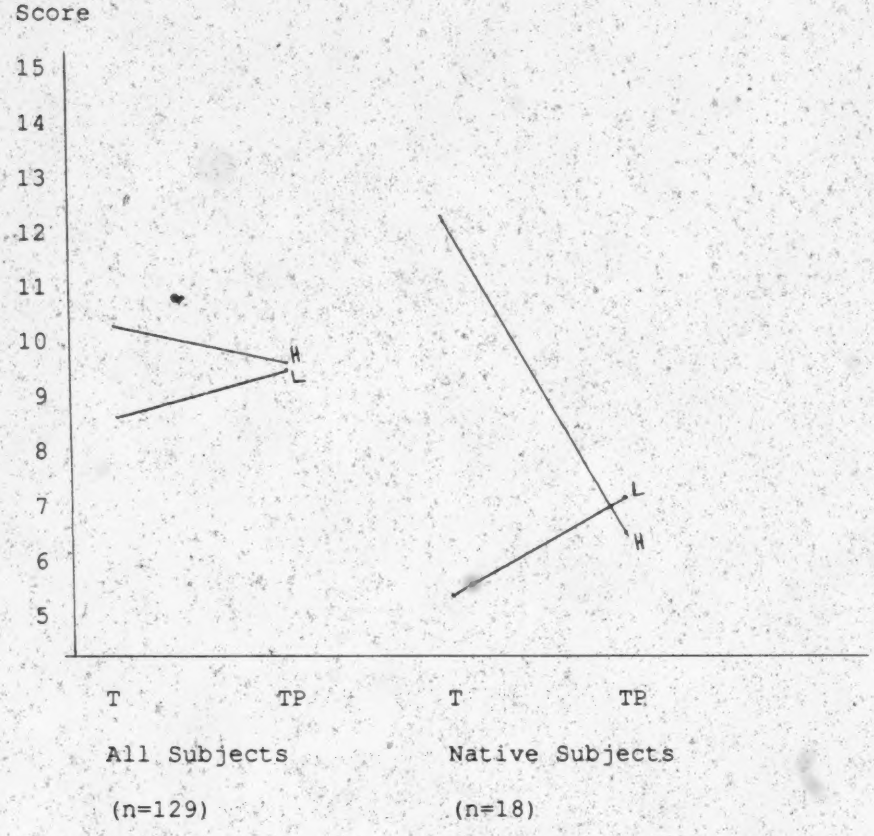


Key:

H=High Visual
L=Low Visual
T=Text Only
TP=Text Plus Analogical Pictures

Figure 5

Observed Means of Open-ended Questionniare for all Subjects (n=129) and Native Subjects (n=18)



Key:

H=High Visual
L=Low Visual
T=Text Only
TP=Text Plus Analogical Pictures

more pronounced. Both the small number of Native subjects (n=18), and the disproportionate number of females in this sample (n=14), make any general conclusions drawn about cultural differences very tentative.

Table 3 (on page 72) shows a summary of all significant ($p < .05$) correlation coefficients for Native (n=18) and non-Native (n=111) subjects. There appears to be a number of differences in the strength of the relationships between certain variables, most notably: a) the multiple-choice test pre-scores and open-ended questionnaire scores (.55 for the Native subjects versus no relationship for the non-Native subjects), b) the multiple-choice test pre-scores and the Verbal Reasoning scores (no relationship versus .59), c) the multiple-choice test post-scores and Verbal Reasoning scores (no relationship versus .48), d) the Verbal Reasoning scores and the Space Relations scores (no relationship versus .48), e) the Space Relations scores and gender (-.50 versus no relationship), and f) the Imagery Scale scores and age (.48 versus no relationship).

Overall, the Native and non-Native subjects appear to be responding in very different ways to the two outcome performance measures, depending on their learning style. They also seem to be influenced by quite different variables (eg. Native subjects were influenced less by verbal reasoning and more by preference to use imagery, than were their non-Native counterparts).

Gender. While the investigation of gender differences was not part of the hypotheses, differences in response patterns arose from the data. Cronbach's Alpha coefficients were calculated for the two measures of the dependent variable by gender, revealing no gender differences in reliability for the open-ended questionnaire (.79 for females and .80 for males)but clear differences for the multiple-choice test (.64 for females and .48 for males).

Pearson Product-Moment coefficients calculated by gender for all variables (see Table 4 on page 73) also indicated some diversity in the strength of the relationship between the multiple-choice test scores and these variables: a) multiple-choice test pre-scores and Verbal Reasoning scores (.61 for females versus .42 for males), b) multiple-choice test post-scores and Verbal Reasoning (.50 versus .34), c) Imagery Scale scores and multiple-choice test pre-scores (.19 versus .34), and d) Imagery Scale scores and multiple-choice test post-scores (no relationship versus .31).

Overall, it appears that the female subjects responded in a much more consistent manner to the multiple-choice test (post-testing session) than did their male counterparts, and that their outcome performance was influenced to a different degree by verbal reasoning (more) and a preference to use imagery (less).

Age/educational background. Independent groups t-tests revealed significant ($\underline{t}$=-2.04,$\underline{p}$=.05) differences between the

Native and non-Native subjects, as well as between female and male subjects ($t=-2.01, p<.05$) in the number of years of schooling achieved prior to attending their respective programs. Both non-Native and/or male subjects had significantly more schooling than did their Native and/or female counterparts.

Inter-correlations of interest. Pearson Product-Moment coefficients were calculated for all variables measured in this study. Table 2 (see page 71) shows a summary of all of the significant ($p<.05$) coefficients for the total subject group (n=129), as well as the smaller subject grouping (n=70). While most of the correlatons are very similar, there are a few exceptions: a) multiple-choice test post-scores and Verbal Reasoning scores (.56 for the total group versus .67 for the smaller group), b) open-ended questionnaire scores and Verbal Reasoning (.46 versus .54), as well as c) Space Relations scores (.24 versus .40), and d) age (.40 versus no relationship). The smaller (and more motivated) subject group's outcome performance scores appeared to be more strongly related to their Verbal Reasoning scores, less by their Space Relations scores, and not at all by the number of years of schooling achieved prior to entering their programs.

For the total subject group (n=129), strong significant correlations were found between these variables: multiple-choice test pre- and post- scores (.63), and multiple-choice test pre- scores and Verbal Reasoning subtest scores (.56).

Moderately significant correlations were found between these variables: a) Verbal Reasoning and Space Relations subtest scores (.48), b) multiple-choice test post- scores and Verbal Reasoning subtest scores (.46), c) multiple-choice test post- scores and open-ended questionnaire scores (.42), d) open-ended questionnaire scores and age (.40), e) Verbal Reasoning subtest scores and number of years of prior schooling (.36), f) Space Relations subtest scores and number of years of prior schooling (.35), g) multiple-choice test pre- scores and grade level (.33), and h) Space Relations subtest scores and I.D.Q. Imagery Scale scores (.30).

Weak but significant correlations were found between these variables: a) Verbal Reasoning subtest scores and I.D.Q. Verbal Scale scores (.27), b) multiple-choice test post- scores and age (.23), c) I.D.Q. Imagery Scale scores and I.D.Q. Verbal Scale scores (.23), and d) Space Relations subtest scores and gender (.22).

Summary of Results

Hypothesis one. Hypothesis one was not supported. Analysis of covariance failed to reveal any significant main effects for instructional condition, but did reveal that subjects' learning style did account for a significant amount of the variance. While all subjects achieved significant gains from pre- to post- testing on the multiple-choice test, L visual subjects made significantly larger gains than did the H visual subjects.

Hypothesis two. Hypothesis two was not supported. Analysis of covariance for the total subject group did not reveal any significant interaction effects for subjects' learning style or instructional condition.

Other findings. Significant correlations were found for the total subject group between: a) the multiple-choice test pre- and post- scores, b) between these scores and Verbal Reasoning subtest scores, c) between both aptitude measures (Verbal Reasoning and Space Relations), d) between both performance outcomes measures (multiple-choice test and open-ended questionnaire), and e) between the Verbal Reasoning subtest scores and the number of years of schooling achieved by subjects prior to entering their program.

There were significantly different patterns of correlations found for non-Native versus Native subjects, and for female versus male subjects. As well, Native (both genders) and female non-Native subjects had significantly lower levels of schooling prior to entering their programs than did the male non-Native subjects.

Chapter V

DISCUSSION OF RESULTS

Purpose of the Study

The purpose of this study was to explore the ability of analogical pictures to function as embedded "cognitive tools" in self-instructional materials designed to teach higher level concepts to adults. The learner attribute of interest was learning style, conceptualized as either High or Low visual. It was hypothesized that while all subjects would benefit from the presence of analogical pictures in the instructional materials, high visual subjects would benefit more from this element than would low visual subjects. Variables that have emerged as significant in previous research (prior knowledge of the instructional content, verbal ability, gender, educational background, age and culture) were examined for their influence on the performance outcomes in this study.

This chapter begins by discussing the findings of the study as they relate to each of the two hypothesis tested, and the variables that appeared to have significantly influenced subjects' performance outcomes. The discussion continues with implications drawn from these findings about these three components of the instructional design process: a) the learner, b) the learning task, and c) the learning environment. The chapter concludes by discussing the study's limitations in terms of theoretical and experimental problems, as well as the question of the generalizability of the findings to other learner populations.

Discussion of the Hypotheses Tested

The focus of this discussion will be on the results as they relate to how analogical pictures affected the subjects' ability to complete learning tasks at two different levels of complexity, and the influence of subjects' learning style on task completion. The relationship of other variables to the performance outcomes is discussed in detail later in the chapter, and therefore will be referred to only as they support the points made in this section.

Hypothesis one: Instructional materials supplemented with relevant analogical pictures will produce higher performance outcome scores in all subjects than will identical instructional materials not supplemented with relevant analogical pictures.

This hypothesis was not supported by the research results. When the effects of subjects' prior knowledge and verbal ability were removed, no main effects were demonstrated on either performance outcome measure for instructional condition. The pattern of responses on the two different outcome measures were different however, depending on subjects' learning style. Non-significant trends in the analysis of the multiple-choice test post-scores lent some support to hypothesis one for L visual subjects, while non-significant trends in the open-ended questionnaire scores were exactly the opposite to results hypothesized.

All subjects achieved a significant gain in their comprehension of planning concepts (as measured by the multiple-choice test) across both instructional conditions. The L visual subjects achieved significantly higher overall performance scores than did the H visual subjects. It was the subjects' learning style, and not the instructional condition that was responsible for a significant amount of variance in the performance outcomes. In other words, the subject's learning style was more critical to their successful learning of the planning concepts than was the visual or non-visual nature of the instructional materials.

An examination of the multiple-choice test pre-scores (see Table 9) revealed that H visual subjects entered the learning situation knowing a significant amount more about the content of the instruction than did the L visual subjects. The H visual subjects also scored significantly higher on the Verbal Reasoning subtest than did the L visual subjects. Their scores on the two performance measures indicate that it was likely these two variables (verbal ability and prior knowledge), rather than learning style, that were responsible for H visual subjects' superior performance scores. The more intriguing finding is that these higher visual and higher verbal subjects appeared to be unaffected by the analogical pictures on the more complex task of concept comprehension (as measured by the multiple-choice test), while appearing to be negatively affected by these pictures on the simpler task of concept recall (as measured by the open-ended questionnaire). L visual subjects performed in exactly the opposite manner than did H visual subjects, appearing to be negatively affected by the analogical pictures on the more complex task and unaffected by these pictures on the simpler task.

The overall gains made on the more complex task from pre- to post-testing by both L and H visual subjects then, appeared to be similarily effected by a factor common to both instructional conditions, or the verbal instructional techniques, while differentially affected by the visual instructional technique. The fact that the text element of the instructional materials (identical across the two instructional conditions) produced significant gains, supports existing research evidence on the effectiveness of the six verbal instructional techniques built into both instructional conditions: a) behavioural objectives, b) advanced organizers, c) inserted questions, d) underlined keywords, e) examples, and f) verbal analogy. Designed according to well established principles, these non-visual elements could be expected to result in significant knowledge gains in subjects, regardless of differences in their learning style (Gagne, Briggs & Wager, 1988; Kozma & Bangert-Drowns, 1987). It is also possible that the use of the verbal analogy in the text element may have contributed to the slight differential affects, by being evocative enough to render the T instructional condition "visual" for the H visual subjects. The presence of the embedded visual element in the TP condition at the same time, may have hindered the H visual subjects' ability to use their own spontaneous mental imagery (Stein et al, 1987; Taylor et al, 1987). These two factors together could account for results that were opposite to those hypothesized for H visual subjects.

The effect of the visual instructional technique seems to be related to the level of complexity of the task and the learning style of the learner. From the strong and moderate correlations found between the multiple-choice test pre- and post- scores and the Verbal Reasoning subtest scores (.56 and .46) (see Table 2), it appears that the primary cognitive processing skill being utilized by both L and H visual subjects in the performance of the more complex task was verbal. A much weaker correlation was found between the Space Relations subtest scores and the multiple-choice test scores (.36 and .33), and between the Imagery Scale score and these scores (.25 and .17). On the other hand, there is no correlation between the Verbal Reasoning subtest score and the open-ended questionnaire (the less complex task), indicating that this task may not be as strongly dependent on verbal skills. In Table 5, moderate correlations between Space Relations subtest scores and the open-ended questionnaire (.30) and the multiple-choice test post-scores (.25) appear for the L visual subjects only. Quite different cognitive processes are being used by subjects to complete the learning tasks, with the L visual subjects relying more heavily on spatial skills than the H visual subjects.

Hypothesis two: Instructional materials supplemented with relevant analogical pictures will produce higher performance outcome scores in subjects demonstrating a more visually-oriented learning style (as measured by the Space Relations subtest of the Differential Aptitude Test and the Imagery Scale of the Individual Differences Questionnaire).

This hypothesis was not supported by the research results. As discussed in the previous section, all subjects made significant gains across both instructional conditions, with the L visual subjects making more overall gains (in the hypothesized direction on the more complex task) than did the H visual subjects. Non-significant trends in the data on the open-ended questionnaire indicate a tendency towards interaction (see Figure 5) in the opposite direction to that hypothesized, with the H visual subjects achieving less in the TP instructional condition than they did in the T instructional condition.

The fact that the L visual subjects made better gains on the more complex task in the T instructional condition could be seen as support for Paivio's dual code model of information processing. Paivio (1986) postulated that higher level cognitive tasks are "verbal" in nature and better handled in a verbal mode. The fact that L visual subjects were not assisted in the simpler recall task by the TP condition could also be explained as a function of the more "abstract" (ie. verbal) nature of planning concepts. The apparent negative effect of the analogical pictures on the H visual subjects performance of the simpler recall task is also consistent with this aspect of Paivio's model.

The results for the small group of Native subjects clearly do not support Paivio's model. Native subjects performed both learning tasks in exactly the opposite manner than that hypothesized. Their performance was apparently unaffected by the complexity of the learning task. The results for the L visual Native subjects seem to support a compensatory model of information processing that suggests that visuals can "short-circuit" learning by reducing the cognitive processing load for low (verbal) ability learners (Corno & Snow, 1986). This conclusion is supported by the stronger relationship between the Native versus non-Native subjects' overall preference to use imagery and their multiple-choice test pre-scores (.57 versus .19) and the Native versus non-Native subjects' spatial ability and open-ended questionnaire scores (.40 versus .16).

These same trends in the data could also be seen to lend support to an interactionist perspective of information processing that postulates that L visual subjects (who were also the lower verbal subjects) have fewer skills in symbol system manipulation across a semantically oriented knowledge domain (Kolers et al, 1978, 1984). The assertions that different symbol systems demand different cognitive processes and abilities on the part of the learner (Salomon, 1979; Sternberg & Weil, 1980; Taylor et al, 1987), and that general or verbal learning ability may be the most reliable and strongest predictor of learning achievement (Cronbach & Snow, 1977) are also both supported by these trends.

Overall, these results seem to indicate that analogical pictures may serve both a positive role (perhaps as conceptual pegs for the lower ability, Native subjects in the free recall performance task) and a negative role (perhaps as distracting stimuli for the higher ability, Native subjects in the free recall performance task, and for the lower ability non-Native subject group in the more complex multiple-choice performance task). Research that compares the performance outcomes of low ability and high ability students on both lower and higher level concept acquisition lends support to this explanation (Cronbach & Snow, 1977; Peeck, 1987; Winn, 1982a).

The fact that H visual subjects scored significantly higher on the Verbal Reasoning subtest means that they were also the higher "verbalizers", suggesting that these subjects may have had a wider range of verbal and spatial cognitive strategies available to them. The finding that H visual subjects appeared to be hindered by the TP instructional condition, however, is inconsistent with research that indicates that subjects with higher spatial and verbal abilities are more able to shift their information processing strategy to fit the processing demands of the particular learning task (Cronbach & Snow, 1977). That H visual subjects were hindered by the analogical pictures, supports Taylor's hypothesis (Taylor et al, 1987) that high spatial-visual learners may be distracted by the presence of embedded visuals that are not consistent with those already effectively used by these learners. On the other hand, L visual subjects did not appear to be effected by the pictures at all, perhaps because they were not able to use a visual strategy without possessing the required verbal and spatial abilities (Kyllonen et al, 1984; Sternberg & Weil, 1980).

There are also some plausible instruction-related explanations for the lack of support for the two hypotheses in this study. The six verbal techniques used in both instructional conditions may have reduced the performance differences among the high and low visual subjects to the point that the analogical pictures did not contribute a significant amount to the learning. A more robust test of the contribution made by the addition of analogical pictures would omit some or all of these well established verbal techniques from the instructional conditions.

It is also possible that the particular learning tasks presented to the subjects in this study (especially the more complex one) were not sufficiently "spatial" enough to be affected by a lack or presence of spatial-visualization ability or visual sensory modality information processing preference. This hypothesis is supported by the moderately strong correlations found between subjects' outcome performance scores and their Verbal Reasoning subtest scores (see Table 3).

Another plausible explanation is that the informational content of the visuals used in this study was either limited in its ability to aid higher level concept comprehension, or was not the most appropriate for assisting in the comprehension of these concepts. The analogical pictures offered primarily redundant, as opposed to additional, information that might have helped clarify confusing verbal relationships between concepts. An item analysis of the multiple-choice test post scores would more accurately pinpoint those concepts most in need of further clarification.

Some of the analogical pictures that were used may also have interfered with information retention by diverting both the H visual subjects' attention away from the less complex learning task, and the L visual subjects away from the more complex learning task (Stein et al, 1987).

In summary, the research findings indicated that the presence of analogical pictures in text-based, self-instructional materials did not significantly affect subjects' outcome performance. These findings, however, did clearly indicate that the subjects' profile of cognitive abilities and preference to use their visual sensory modality does affect their ability to acquire higher level concepts from these instructional materials.

Discussion of Other Findings

Culture. Having a Native, cultural background appears to have been an important factor in the performance outcomes and learning processes used by the subjects in this study. The small group of Native subjects performed very differently from their non-Native counterparts. This Native group also appeared to possess very different learning styles from that of Native subjects reported in other research. While the typical distribution of a visual versus verbal sensory modality preference for processing information within any one population is assumed to be evenly distributed, a substantial amount of evidence exists that the North American Native population is more likely to be visually-oriented than are their non-Native counterparts.

It is important to note that culture bias in all of the instruments used in this study could have contributed to the lower scores for the Native subjects. Both instruments used to assess subjects' learning style (Space Relations subtest of the D.A.T. and I.D.Q. Imagery Scale) were developed on a white, middle-class population. An examination of the I.D.Q.

(see Appendix H) reveals that a number of items may be culturally biased (e.g. item 49: "I enjoy solving crossword puzzles and other word games").

More (1987) documents a number of studies of younger Native learners that demonstrate their strength in using visual/perceptual/spatial information. It appears that many Native students frequently and effectively use coding with imagery (either concrete or abstract) to learn new concepts.

Kauback (1984), in an extensive review of North American research, concluded that Native children have a predisposition to a visual style of learning (possibly as a result of environmental or social factors - see also Arbess, 1981, and Swisher & Deyhle, 1989) that may handicap their ability to learn from verbally-oriented materials. It appears that the use of visual materials results in more effective learning by these students.

Two important differences exist between the subjects reported in previous research and the subjects in the present study; this study's subjects were older and from a very select group. The fact that they were enrolled in a pre-university and college program means that they are probably more academically successful and therefore, verbally-oriented than their peers. This likelihood is supported by the strong correlation between the open-ended questionnaire scores and age (.61), as well as between their Verbal Reasoning scores and grade level (.60). The moderate correlation between their I.D.Q. Imagery Scale scores and age (.48), and Space Relations scores and age (.48), would suggest that the use of mental imagery still plays a significant role in the learning processes of these Native adult learners. The seemingly contradictory finding that Native subjects tended to be categorized as Low visual learners in this study could be a function of a generally lower academic level, as well as the presence of culture bias in the instruments.

Gender. In this study, female subjects were less visually-oriented than were male subjects. As well, female subjects exhibited a much more consistent pattern of responses on the multiple-choice test than did male subjects. In accordance with these observations, female subjects' performance outcomes also appeared to be more strongly infuenced by verbal reasoning ability, and less influenced by a preference to use mental imagery.

These differences in the learning styles of female versus male subjects directly contrast with those of undergraduate female subjects' described in two previous studies on the use of imagery and visual sensory modality preference in learning (Ernest & Paivio, 1971; Hiscock, 1978). Both of these other studies, using the Individual Differences Questionnaire and an objective test of spatial relations to assess subjects' learning style, found that the female subjects tended to have higher visual learning styles than did the males. The reverse outcome in the present study could be related to the fact that the present study's female subjects are representative of generally lower achieving females who leave high school before graduating. This hypothesis is supported by Space Relations and Verbal Reasoning scores that were lower than those of their male counterparts, and the fact that the female subjects had significantly less schooling than their male counterparts.

In an exploration of gender specific response patterns on the I.D.Q., Harshman and Paivio (1987) found that females more frequently endorsed memory and vividness imagery items, while males more frequently endorsed problem-solving and moving imagery items. The authors suggest that those items more frequently endorsed by females are descriptive of "static" image use, while those endorsed by males represent "transformational" image use. The female subjects' lower Space Relations scores (considered a measure of transformational imagery) are consistent with this explanation, as well as with research on gender performance differences on objective tests of imagery ability (Maccoby & Jacklin, 1974).

Age/educational background. The moderate correlations between the performance outcome measures and age (.40) and years of school attended (.33), as well as the two aptitude subtest scores and years of prior schooling (.36 and .35) likely indicates that the more recent a subject's experience in a formal school setting, the more likely s/he was to do better on school-like performance tasks. The weak correlation between age and the multiple-choice test post-score could be reflecting the fact that the younger the subject, the less time s/he had been out of school.

Inter-correlations of interest. Pearson Product-Moment coefficients calculated on all of the variables measured in this study indicate that a number of them appear to be moderately to strongly related to both of the performance outcomes measures and to each other (see Table 2).

As expected, the two performance measures are moderately related (.42), which could indicate that they were both measuring the same knowledge domain. Each instrument was designed to assess different levels of the subjects' knowledge of the five stage planning process (see Chapter III). The fact that the response patterns for these two instruments were quite different, as well as the correlation patterns between the multiple-choice test post-scores, open-ended questionnaire scores and verbal and spatial ability measures, supports the claim that these two tasks required different cognitive processing skills.

The weak correlation between the Space Relations subtest scores and the I.D.Q. Imagery Scale (.30), and the Verbal Reasoning subtest scores and the I.D.Q. Verbal Scale (.27) supports claims that the objective and subjective components of this learning style are distinct (Katz, 1983; Paivio, 1986; Richardson, 1980). The weak correlation between the two scales of the I.D.Q. (.23) also supports Paivio's claim that the Imagery and Verbal Scales are not related and that being a "verbalizer" is not simply the reciprocal of being a "visualizer" (Hiscock, 1978).

Conclusions and Implications

Conclusions and implications about all three components of the design of instruction (specifically, text-based, self-instructional materials) for adult learners can be made from the findings of the present study.

The learner component of instruction. In terms of the research questions posed in Chapter two:

1. The presence of analogical pictures alone does not significantly effect all learners' ability to acquire higher level concepts. These pictures do, however, have an effect when coupled with the learners' profile of verbal and spatial skills (see points 2 and 4 below).
2. The learners' verbal reasoning ability (as measured by the Space Relations subtest of the D.A.T.) does affect the learning outcome. The presence of stronger verbal skills was a relevant predictor of performance in both tasks presented in this study.
3. The learners' prior knowledge of the content of instruction does significantly affect the learning outcomes. How much the learner knew about the

planning process was a strong predictor of performance in both tasks presented in this study.

4. The learners' learning style (as measured by the Space Relations subtest of the D.A.T. and Imagery Scale of the I.D.Q.) does significantly affect the learning outcomes. High visual learners benefitted from the presence of analogical pictures in some (more complex) learning tasks, and were hindered by the presence of these pictures in other (less complex) learning tasks. The opposite was true for low visual learners.
5. The learners' gender, culture and years of prior schooling affects the learning outcomes. In particular: a) Native learners have a stronger preference to use mental imagery, and are less influenced by verbal reasoning than are their non-Native counterparts, b) female learners have a weaker preference to use mental imagery, and are more influence by verbal reasoning than are male learners, and c) the number of years of formal schooling (and indirectly, age) is positively related to performance outcomes.

These findings generally lend support to a compensatory model of instructional design for adult learners at the pre-university and college level. Text-based, self-instructional materials for this group of learners should take into consideration the strength of their verbal and spatial cognitive processing skills, as well as the amount of relevant knowledge they bring to a learning situation. Other key learner characteristics that appear to warrant further study are cultural background and gender, as these variables appear to influence the manner in which learners process information.

The learning task component of instruction. It appears that the acquisition of lower (i.e., knowledge) versus higher (i.e., intellectual abilities and skills) level concepts is differentially affected by the presence of analogical pictures, depending on the learner's learning style. While lower level concept acquisition is negatively affected for H and positively affected for L visual learners in general, higher level concept acquisition is affected in the opposite manner for learners' in general. The former pattern appears to be true for Native learners in both lower and higher level concept acquisition.

These findings provide support for the careful pre-assessment of the learning task. Systematic instructional design methods for analyzing the learning task (such as Life Role Analysis) can be utilized for this function, whether or not the final learning context follows a mastery learning format.

The learning environment component of instruction. From the findings of this study, it can be tentatively concluded that the degree of perceived immediate task relevance affects adult learners' motivation to complete the learning task. The absence of perceived relevance can reduce the reliability of the performance outcome scores.

This conclusion emphasizes the need to carefully analyze at least these two factors in the learning environment: a) the degree of self-directedness of the learner, and b) the appropriateness of the specific content of instruction for a text-based, self-instructional learning format.

Limitations of the Study

Theoretical. A number of researchers have described critical design problems that have historically plagued attribute treatment interaction studies (Colorado, 1988; Cronbach & Snow, 1977; Dwyer, 1978). Lindquist (1953) cautions that when interpreting significant treatment-by-level interactions, it is virtually impossible to determine if the treatment conditions or some other single variable or multiple variable interaction accounted for the differences in experimental outcomes. In this study, the two identified learner variables that accounted for a significant amount of the differences in experimental outcomes were subjects' prior knowledge of the instructional content and verbal reasoning ability. Other identified learner variables that appeared to be related to the performance outcomes for certain groups of subjects were gender and cultural background. It was also speculated that an unidentified variable, motivation to complete the learning task, may have negatively influenced the performance outcomes of some subjects.

Cronbach and Snow (1977) and Colorado (1988) acknowledged the difficulty of controlling for the vast number of variables (learner and learning environment) that are present when a research study is conducted in the field. Some environmental variables that may have affected subjects' performance in the present study were: academic stress experienced by subjects (primarily high school drop-outs) returning to a formal school setting after a sometimes lengthly absence, and the possible lack of motivation on the part of some of the subjects to take the experimental tasks seriously.

Experimental. Most experimental problems associated with attribute treatment interaction studies center around the difficulties of obtaining reliable and valid measures of the variables being studied. The independent variable in this study that was, to a certain extent, vulnerable to this problem was the assessment of subjects' learning style. The dependent variable in this study was also vulnerable to this problem, as one of the performance outcome measures displayed a less than desirable level of reliability.

The problem traditionally associated with attempts to assess imagery ability began with the difficulty of defining the construct of "mental imagery" clearly enough to construct a reliable measure of it (DiVesta, Ingersoll & Sunshine, 1971; Katz, 1983; Snow, 1976). Over the course of several years of research, a number of objective measures of spatial-visual ability (such as the Space Relations subtest of the D.A.T.) have emerged that assess subjects' ability to effectively use mental imagery (Eliot and Smith, 1983). Recently, Paivio (1972) developed a self-report measure of sensory modality preference that has been used by researchers to diagnose subjects' propensity to use their visual as opposed to their verbal, sensory modality to process information (Ernest, 1977; Katz, 1983). While the Individual Differences Questionnaire has been recognized as a useful instrument for investigating the concept of visual imagery as a cognitive style (Hiscock, 1978), it has not received enough study to have well established construct validity (Ernest, 1977; DiVesta et al, 1971).

Cronbach's Alpha coefficients for the two performance outcome measures were .79 for the open-ended questionnaire, and .59 (total subject population) to .67 (more motivated subject sub-group) for the multiple-choice test. These coefficients indicate good internal consistency for the open-ended questionnaire, but poor internal consistency for the multiple-choice test. Further analysis of the multiple-choice test data (factor analysis, inter-correlation, right/wrong response pattern analysis) was conducted without revealing any clearly interpretable response pattern for the total subject group. However, multiple-choice test pre- and post-score Cronbach Alpha coefficients by subject grouping revealed that three subject groups' post-testing responses decreased in terms of consistency. The most plausible explanation for this drop in reliability from pre- to post-testing on the multiple-choice test is that these subjects' motivation to complete this difficult learning task decreased in the post-testing session. All three subject groups displaying this response pattern were in academically demanding programs, and the post-testing session occurred just before mid-term exams. The group that dropped the most was a highly task-oriented class with a history of resisting assignments perceived as academically non-relevant (personal communication from the Co-ordinator of the program). Coupled with the strain of being re-entry students in the first semester of a demanding program, this learning environment factor may have negatively affected their motivation to attend to a task that did not appear to be directly relevant to their immediate academic success.

The other factor that may have contributed to the lower than desired level of reliability of the multiple-choice test could have been the acknowledged difficulty of constructing multiple-choice test items that reliably measure higher level or abstract concepts (Bloom, 1956; Ferguson, 1981; Stanley & Hopkins, 1972). Overall, while an unreliable outcome measure does not necessarily bias the interpretation of an attribute treatment interaction study, it does make it harder to show statistical significance (Cronbach & Snow, 1977).

Some of the lack of consistent research findings regarding the use of visuals in treatment studies has been attributed to the difficulty of measuring nonverbal learning outcomes with verbal performance measures (Canelos, Taylor, Dwyer & Belland, 1988; Dwyer, 1978; Szabo et al, 1981). This problem is particularly important when the performance objective is the demonstration of a nonverbal skill (such as identifying parts of an object). While this study did not target such nonverbal outcomes, it is important to acknowledge the possibility that some relevant nonverbal learning (such as a strategy for nonverbally conceptualizing the planning process) did occur that was not assessed by the verbal performance measures used in this study.

Generalizability of findings. One of the most important issues to be addressed by any researcher is that of the generalizability of the findings of a study to populations other than the subject group. In this study, the subject population was female and male adult learners enrolled in university and college preparation programs in a Northern Alberta city. The non-Native subjects' mean scores on objective measures of verbal and spatial ability fell within the average to above average range (Canadian norms) for their education level. Mean scores on a subjective measure of visual sensory modality preference were somewhat lower than those obtained for undergraduate, Canadian, females in other studies (123.64 versus 133.51) but identical for males (Hiscock, 1978). While this subject group does not appear to be generally similar to the undergraduate Canadian student population, because it was drawn from three different Alberta institutions, it is probably representative of pre-university/college, re-entry students across Alberta.

On the other hand, the small group of Native subjects in the study appeared to differ in a number of ways from their non-Native counterparts. They scored somewhat lower on all of the measures and performed very differently on the performance outcome measures than did their non-Native counterparts. As this Native group was an intact classroom from one Alberta institution only, it is less likely that it represents Native, pre-university/college, re-entry students across Alberta.

The results of this study should, therefore, be generalizable to other non-Native, re-entry students registered in university and college preparation programs in Alberta. The findings for the Native subjects, however, should be regarded with caution, due to the small numbers involved, the less representative sample, as well as the disproportionate number of female subjects in the sample.

Summary

This study examined the role of analogical pictures in adult learners' acquisition of higher level (abstract) concepts. It was hypothesized that these non-notational visuals would act as "cognitive tools" for all learners, while being particularly facilitative for learners with higher visual learning styles.

The findings indicated that analogical pictures appear to function as cognitive aids, but in a manner opposite (on the less complex learning task) than that hypothesized. As well, it appears that both culture and gender influence the subjects' manner of information processing. Overall, this study lends support to a compensatory model of instructional design (Corno & Snow, 1986; Cronbach & Snow, 1977), suggesting that text-based, self-instructional materials for low verbal and low visual adult learners could be improved by the addition of analogical pictures.

The complex nature of this field study means that a number of unidentified variables may have been influencing the research results. Given this possibility, a number of directions for future research are suggested to follow-up this study: a) an exploration of the effects of both culture (using a larger and more representative sample of Native subjects), and gender on the performance of both lower and higher level learning tasks, b) an exploration of factors effecting subjects' decisions to use verbal and/or visual learning strategies across different levels of learning tasks, and c) an exploration of how analogical pictures, embedded in text-based self-instructional materials, effect adult learners' motivation to complete lower and higher level learning tasks. This latter research would demand an extensive inquiry into the relative contribution of the text and pictorial elements of the instructional materials.

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APPENDIX A: Life Role Analysis

1. Overview of the Model
2. Design Template for Instructional Booklet
3. Instructional Booklet (TP Version)

Overview of the Model

Occupational life roles have three components:

1. outcomes or goals to be achieved.
2. processes or general ways of reaching goals.
3. structures or techniques that are used to carry out the processes.

The Life Role Analysis process for identifying these three components is called "profiling". The profiler, through the technique of interviewing an expert in the life role in question, systematically organizes these components into:

1. a skill profile of competencies used by persons who function expertly in this life role. This profile is organized into general areas of competence that form a number of bands on the profile.
2. instructional design templates for each competency that outline the subordinate skills contained within each competency, and guides the process of designing instruction that will teach the learner how to function competently in the life role.

Designing the instruction material involves:

1. determining the instructional content required for each learning task,
2. selecting instructional techniques for introducing the instructional content and guiding the learner throught it, and
3. developing informal assessment instruments that serve as learner reviews and self-checks for each learning task.

The end product is a series of instructional modules which each contain written learning tasks that assist the learner to acquire each competency.

Life Role Analysis uses Gagne's nine events of instruction to design the instructional component of the text, collapsing the nine events into these three: a) provide motivation (for gain attention, give learning objective, and stimulate recall of prior learning), b) provide guidance (for present stimulus, provide guidance and elicit performance), and c) provide practise (for provide feedback, assess performance and enhance retention and transfer).

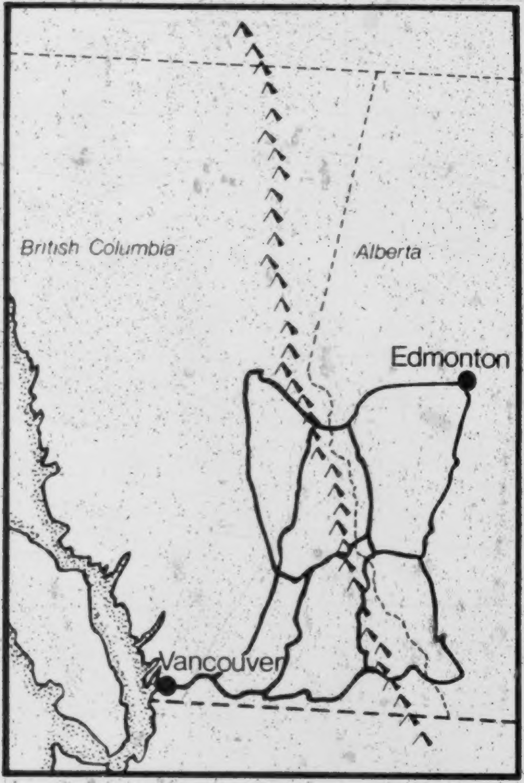
INSTRUCTIONAL DESIGN TEMPLATE

Identify the Stages of the Planning Process	Given five short case studies, the learner will correctly identify the five stages of the planning process.

CAPABILITIES	TYPE OF CAPABILITY	INSTRUCTIONAL TECHNIQUES
1 State the stages of planning and their purposes	Verbal Information	M - explain and inform G - readings P - objective questions
2 Describe determining planning goal(s)	Intellectual Skill	M - explain and inform G - readings P - objective questions
3 Describe gathering information	Intellectual Skill	M - explain and inform G - readings P - objective questions
4 Describe breaking goal(s) into sub-goals	Intellectual Skill	M - explain and inform G - readings P - objective questions
5 Describe making a masterplan	Intellectual Skill	M - explain and inform G - readings P - objective questions
6 Describe evaluating the plan	Intellectual Skill	M - explain and inform G - readings P - objective questions
7 Identify the stages of planning	Intellectual Skill	M - explain G - review P - objective questions

INSTRUCTIONAL BOOKLET

"How to Put Together a Plan"



Entering a new occupation is like taking a journey

Imagine that you have just decided to drive to Vancouver for a holiday during the Christmas break. You have never driven there before, so you are looking forward to the new experience but are not quite sure how to prepare for the trip.

Now, think about the decision that you have just made to enter a new occupation (that is, after all, why you are here in school). You are feeling very excited about this major life change and possibly a little unsure about how to go about making the change.

The experience of entering a new occupation and taking a trip along an unfamiliar route are in many ways quite similar. The way that you choose to prepare for both can influence your chances of eventually reaching both kinds of goals.

First, being very well informed about your new occupation is important. In a similar way, if you did not know where Vancouver was located, you would be very unlikely to arrive there (you may end up somewhere else instead).

Second, finding out as much as possible about your intended occupational choice (is there more than one way to enter this occupation?) is somewhat like finding out if there is more than one highway to Vancouver. Knowing about all of the possible routes allows you to choose the one that suits you best.

Third, the often very long process of entering an occupation can be made more manageable (and often more enjoyable) if tackled in shorter steps. This is like breaking the long trip of several kilometers into a series of shorter trips. Breaking the journey into steps can make it seem less of a "long haul" and more attainable.

Fourth, a good occupational plan outlines your entire "route" and lets you know how well you are progressing towards your goal, just like a good highway map lets you know how far you have come from Edmonton, and have yet to travel to reach Vancouver.

Fifth, a smart occupation-changer is always prepared to cope with problems that may arise, just as a smart traveller is always prepared for emergencies, especially when travelling along a long and unfamiliar route.

Taking the time to prepare for major life changes can have a very positive effect on your ability to make that change successfully. For example, good planning can increase your chances of obtaining that first important job in your new occupation. A good occupational entry plan will also help you to reach your goal when you want to, typically soon after becoming qualified to enter the occupation. On the other hand, finding yourself still looking for that job years after you wanted to change occupations, is often the result of poor planning.

This booklet contains the information that you need to prepare well constructed plans. After completing the booklet, you will know how to put together a plan that will increase your chance of achieving goals like entering a new occupation.

The three questions at the end of each of the first six sections in the booklet, and the exercise in the last section are to help you check your understanding of the planning process as you go. Read each of the sections and then try answering the three true/false review questions that follow. The answers to these questions are listed by section on page 17. If you are still unsure about the answers, go back and re-read the section before moving onto the next one. The first set of questions appear below.

Review Questions: Are the following statements True or False?

1._____ Planning increases the chance that you will reach your goals.

2._____ A good plan begins with a clear description of your desired outcome.

3._____ Planning will not help you cope with all of the problems that may arise as you carry out your plan.

See answers on page 17, Section 1.

Section 2: Describing Your Goal

British Columbia
Alberta
Edmonton
Vancouver

Describing your goal is like describing your destination

One of your friends has just asked you what you are doing over the Christmas break. One way to answer this question is to find a map of British Columbia and point to Vancouver as your desired holiday destination. Showing him/her exactly where Vancouver is located and how many kilometers it is away from Edmonton will give someone who has never been there a pretty good idea of where you are going. If you wanted to be even more descriptive, you could show him/her a map of the route that you are taking to Vancouver and the various activities that you hope to do along the way.

Having a clear idea of where you are headed in your career is just like having a clear idea of where you are going on a trip. Knowing that your final destination is Vancouver means that you will not end up in Regina. Having a clear idea of where you are going greatly increases your chances of actually arriving where you want to be.

In terms of describing an occupational goal, saying that you want to find a job in a "medical setting" is as unclear as saying that you want to spend Christmas in British Columbia. Saying that you want to find a job "as a laboratory technician in a major hospital setting within the next five years" is as specific as saying that you want to spend Christmas in Vancouver, instead of simply saying British Columbia. This change in your goal statement adds important information about the kind of job, the kind of medical setting, and the timeframe in which you want to achieve this goal. With this kind of a goal, you will be much less likely to end up in some other occupational role or setting, as a nurse's-aid or hospital administrator.

When preparing for your trip to Vancouver, you will probably have certain conditions that you need to keep in mind. These conditions could be things like how much money you can afford to spend and how many days you want to be away. If you are like most students, your budget and the number of days that you can take from your studies will be limited. This means that you will need to watch both your money and your time quite carefully.

Entering an occupation often requires a similar kind of care. If you are planning to become a laboratory technician, for example, you may need to consider conditions such as the amount of money and time that you can spend entering this occupation. Being very clear about these conditions beforehand means that you then have a way of keeping track of how well you are sticking to them as you move towards accomplishing your goal.

Once you have a clear idea of the conditions under which you want to become a laboratory technician, you have a way of checking your progress towards your goal by referring back to them from time to time as you work towards your goal. As a traveller, if you do not keep track of the money that you spend and the days that you are away, you may not succeed in getting all the way to and from Vancouver.

The best kind of conditions to have are ones that are fairly easy to observe (two weeks over Christmas and $500.00 to spend, or a three year education/training period and an annual budget of $10,000). Another important rule for conditions is that they take into considertion everything else that is going on in your life. Taking a two week Christmas holiday is not a very good idea if you are failing Math and Chemistry and really need to study for part of the Christmas break. In a similar way, becoming a full-time student for three years may not be possible if you have a large mortgage to pay or young children at home.

When planning, the important thing to remember is that starting with a clearly described goal greatly increases your chance of actually reaching this goal. Having clearly stated conditions for reaching this goal gives you a way to measure your progress and can help to keep you on track.

Review Questions: True/False

1.______Describing your planning goal requires outlining what you want as a result of your efforts.

2.______Not knowing what it is that you will have after reaching your goal reduces your chances of achieving what you want.

3.______The best conditions to set for goals are complex ones.

See answers on page 17, Section 2.

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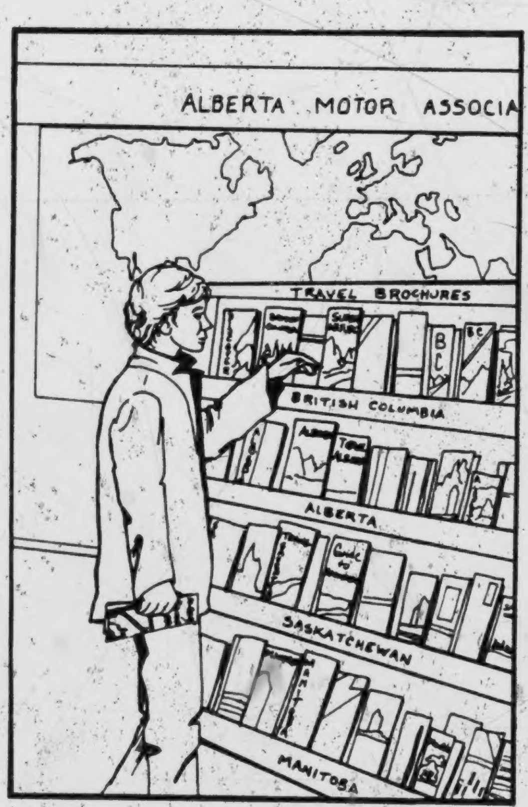
Section 3: Gathering Information



Researching your occupation is like visiting a travel agency

Imagine starting out for Vancouver on the first road that appeared to head in that direction, without checking to see if there were better routes that also lead to Vancouver. This would be like trying to enter the field of medical technology by just opening up the newspaper and applying for these jobs without checking to see is there were other better ways of getting into the field. There are usually many ways to get reach most goals.

The first thing that you will probably do to prepare for your trip to Vancouver is find out about the different highways that go there. You may do this by visiting your nearest Alberta Motor Association travel office to locate maps and brochures that describe these different routes. You may talk to the travel agent about how these routes differ. You may also talk to people who have driven to Vancouver, about the particular routes that they have taken.

In a similar manner, one of the best ways to find out about entering an occupation is to read occupational information and talk to people who are currently employed in the field. For example, gathering information about the kinds of qualifications that employers of laboratory technicians prefer will give you more information about how to get a job in this field. Finding out that hospitals in the Edmonton area prefer to hire laboratory technicians who have graduated from N.A.I.T.'s medical technology program, is very important to your eventual successful entrance into this occupational field in Edmonton.

People who have driven along the Banff-Jasper highway on their way to Vancouver may mention the great skiing opportunities in both Banff and Jasper. Others may tell you about the wonderful restaurants in both towns. If they have travelled along the TransCanada highway through British Columbia, they may mention that there are hot springs along this route. The more brochures and maps that you consult and people that you talk to, the more you will find out about the advantages and disadvantages of each route to Vancouver.

In the same way, the more occupational profiles that you read and the more people who work in the occupation that you talk to, the more you will find out about entering the field. In any case, the more information that you gather about your route (whether geographic or occupational) the more you will find out about the different ways to reach your goal. You may find out, for example, that taking academic up-grading courses or N.A.I.T.'s pre-technology program increases your chances of getting into N.A.I.T.'s medical technology program (a difficult program to get into). You may also discover that all of the people who got into N.A.I.T.'s medical technology program within the past three years had at least a 75% average in the required courses. After checking this piece of information with more than one N.A.I.T. graduate, you will realize that your marks in these courses are more important than you thought.

Finding out as much as possible about your goal generally increases your knowledge about the different options available to you. Knowing how each of the various routes to Vancouver differ allows you to pick the route that you will like the most. In a similar way, the more that you know about how to successfully become employed as a laboratory technician, the more able you are to pick the "route" that will best suit your particular needs and resources.

To review then, after you have clearly described your goal, your next step is to find out as much as you can about how to reach it. After doing this research, you will be better able to chose the best way to work towards your goal.

Review Questions: True/False

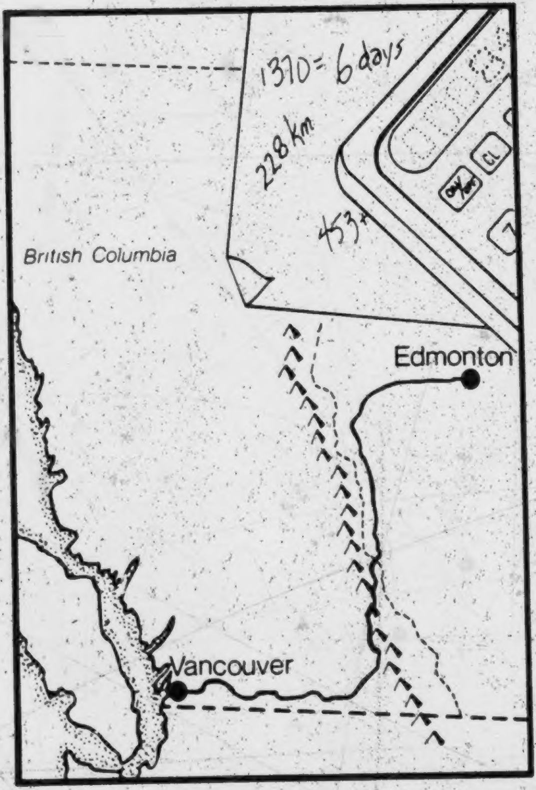
1.______Skills in interviewing people are not important when gathering information.

2.______Talking to people who have direct experience in an occupation is not as important as reading published occupational information.

3.______A plan for reaching a goal that is based on inaccurate information can reduce your chances of reaching that goal.

See answers on page 17, Section 3.

Section 4: Breaking Your Goal into Smaller Steps



Breaking your goal into smaller steps is like dividing a long journey into several short ones

Imagine driving all the way to Vancouver without stopping anywhere along the route. Now, think about driving the same route, this time stopping in Jasper and Banff to ski, and in Radium to swim in the hot springs. The second trip is really made up of several shorter trips that make the long journey more manageable (not to mention a lot more enjoyable).

In the same way, the often very long process of becoming qualified to enter an occupation can be broken into a number of smaller steps. For example, becoming qualified to work as a laboratory technician can be divided into: acquiring the necessary high school credits, taking N.A.I.T.'s pre-technology program, and then taking N.A.I.T.'s medical technology program.

Jasper, Banff and Radium, in addition to offering attractive activities, are all located at very convenient spots along the long route to Vancouver. While Jasper is about one-quarter of the way to Vancouver, Banff is about half way and Radium is about two-thirds of the way to Vancouver from Edmonton. Therefore, each of these destinations also acts as a "marker" to let you know how far away you are from your final destination.

In a similar manner, dividing the long process of qualifying to become a laboratory technician into a series of shorter steps allows you to keep track of your progress as you work toward reaching the larger goal. As each step is successfully completed, you know that you are getting closer to this goal because you can point to the finished high school courses, or years in N.A.I.T.'s pre- or medical technology programs. Having something to point to as evidence of your progress can be particularly important when working towards long-term occupational goals. It is easy to become discouraged if you think about your goal only in terms of being able to apply for a job as a laboratory technician a number of years from now. On the other hand, if you think about this same goal in terms of first getting 75% in English 30 and Math 30 (needed to get into N.A.I.T.'s program), then getting accepted into N.A.I.T., then completing the first semester of classes and so on, the whole process seems less overwhelming.

Reaching each of these smaller sub-goals is like first reaching Jasper, then Banff and then Radium as you travel towards Vancouver. While reaching occupational goals like the ones outlined above may not seem very much like skiing or swimming in the hot springs, the sense of satisfaction at successfully completing a difficult task is similar.

Just as in travelling, each of your mini-destinations or sub-goals in entering your new occupation should make sense to you. As well, each sub-goal should relate in some logical way to your larger final goal. Breaking the process of becoming a laboratory technician into time periods (like semesters) may be helpful for some, while breaking the process into the number of courses completed may be more helpful for others.

In fact, not having personally suitable sub-goals can actually lessen your chance of eventually reaching your larger goal. Consider what would happen if you applied directly to N.A.I.T.'s medical technology program without first acquiring the necessary Math 30 and English 30 credits. You would not get into the program. While you can always try again next year, in the meantime you will have lost one valuable year of becoming qualified. This would be like setting out on your trip to Vancouver without having a map of the route. While you may eventually reach Vancouver, the trip will probably take you a lot longer and end up costing more.

To review then, after clearly describing your goal and finding out as much as possible about it, your next step is to break the whole process of reaching your goal into small, manageable steps.

Review Questions: True/False

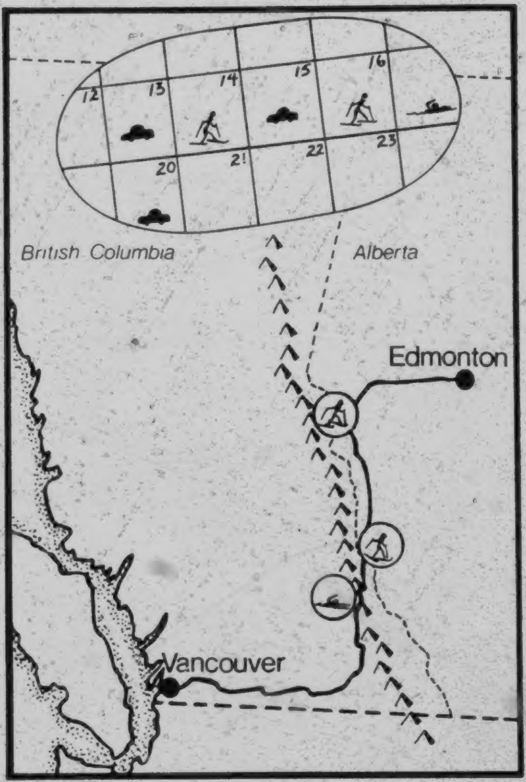
1.______Breaking a large goal into many smaller ones means that you will need more time to reach the large goal.

2.______Sub-goals allow you to measure more easily your progress towards your larger goal.

3.______Successful plans have sub-goals that make sense to the planner.

See answers on page 17, Section 4.

Section 5: Making a Masterplan



Making a masterplan is like putting together a travel schedule

Imagine that you have decided to take six days to travel to Vancouver. You now have brochures, notes from your talks with travellers and travel agents, and a detailed map of the various highways between Edmonton and Vancouver. The townsites of Jasper, Banff and Radium are all clearly marked on this map, as well as the ski hills and hot springs. Because you want to make the most of this six days, your next task is to outline clearly what you want to do in each place that you have decided to stop at along the route to Vancouver.

Putting together a masterplan of how you will enter your new occupation is like drawing up such a travel schedule. Instead of listing where and when you will be skiing and swimming, your occupational entry plan will list specific academic upgrading courses and when you will take them, the N.A.I.T. program that you will attend and when you will attend it,the transcripts and letters that you will need to support your N.A.I.T. application and when you will send for them, and so on. This occupational entry plan will include everything you must do to enter the new occupation, as well as when you must do each of these things.

Such a masterplan will keep you on track as you move towards your goal. Your Vancouver travel schedule will keep you organized as you drive along the route by reminding you that your first stop is Jasper (to ski), your next stop is Banff (more skiing), and your third stop is Radium (the hot springs). Your occupational entry plan will keep you organized by indicating that your first sub-goal is academic up-grading (Math 30 and English 30), your next sub-goal is applying to one of N.A.I.T.'s programs, your third sub-goal is sending for your transcripts and letters, and so on.

A well constructed travel schedule will also help you to stay within the original budget and timeframe that you set for yourself. When putting the schedule together, for example, you may have arranged to stay at bed and breakfast accommodations instead of motels (to save money) and decided to skip the Whistler Mountain sky tram in Jasper (to save time). Both staying within your budget and keeping to your two week timeframe are important aspects of your original goal to go to Vancouver for Christmas.

In a similar way, a good occupational entry plan will help you to stay within the important conditions that you originally set for yourself. With the example being used here, this means that your occupational entry plan should allow you to find a job as a laboratory technician in a major hospital setting within the next five years. A plan to take two academic up-grading courses each year for the next two years, and apply to N.A.I.T. as a full-time student for a period of two years would meet these conditions.

Failure to put together a masterplan that takes into consideration your particular life circumstances can reduce your chance of achieving your goal. A plan to enroll as a full-time student and also work full-time, for example, may result in you having to drop out of your program. A realistic plan works around important occupational and non-occupational realities.

In review then, after describing your goal, researching it and breaking it into smaller sub-goals, your next step is to put together an outline of all of the tasks that must be done to reach your goal, as well as their timeframes.

Review Questions: True/False

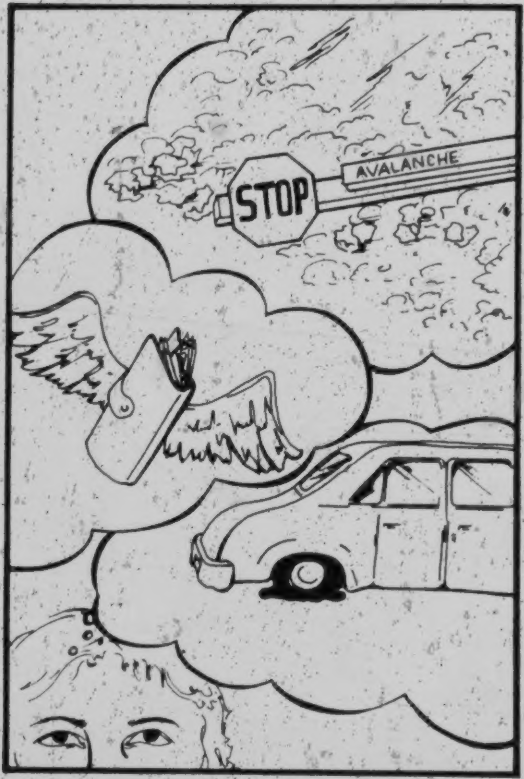
1._____ A good masterplan is both orderly and realistic.

2._____ The "best" order for reaching the same sub-goals will always be the same for different people.

3._____ A good masterplan will help the planner to stay on schedule in achieving his/her goals.

See answers on page 17, Section 5.

Section 6: Evaluating the Masterplan



Evaluating your masterplan is like thinking of what could go wrong on your trip

Imagine starting out for Vancouver in the middle of December without snow chains or a spare tire. If you have done your research beforehand, you would have found out that all of the mountain parks in Alberta and British Columbia require vehicles to have snow chains during the winter months. Your discussions with people who have driven to Vancouver during the winter will have warned you about the importance of having these items with you.

Once on the road, a number of different problems can arise. Some of these, like the possibility of a flat tire, are easier to think of beforehand and deal with in advance. Taking along a spare tire and knowing how to change it will allow you to cope with this particular problem if it happens.

In a similar way, a number of different problems can arise as you work towards your occupational goal. Just as in travelling, some of these can be anticipated and dealt with to a certain extent beforehand. Applying to more than one academic up-grading program to make sure that you get into at least one, is one way to cope with a potential problem before it happens.

Some potential problems require more thought and research to cope with beforehand. The possibility of losing your wallet on the trip, for example, requires that you think of buying traveller's cheques before leaving Edmonton. In this case you will also need to make sure that you have their registration numbers and your bank's phone number stored somewhere handy. In terms of your occupational plan, this would be like realizing that your study skills are rusty or poor and arranging to take a study skills course before starting your academic courses.

Other potential problems are even more difficult to anticipate. Coming across an avalanche on the Banff-Jasper highway that has stopped all traffic means backing up to Jasper and taking another route. If you have your map handy and remember what other travellers told you about the other routes to Vancouver, you will probably be able to quickly re-route yourself. Of course, unless you do find another route you may not make it to Vancouver by Christmas.

In the same way, you may discover that Math 30 is far more difficult than you thought it would be. In this case, modifying your plan in some way may be the only way to still achieve the final outcome that you want. One example of successfully modifying a plan would be to join a Math 30 study group or hire a math tutor. On the other hand, not modifying your original plan may result in your failing Math 30 and not being able to get into N.A.I.T.'s program next fall.

Taking the time to evaluate your masterplan for problems you may run into can significantly reduce the number of problems that you end up having. This step will not make your plan totally problem-free. But this step can go a long way towards making the actual journey smoother and more enjoyable.

In review then, the five steps of the planning process in the order that they should occur are:

1. to clearly describe the goal of your plan,
2. to thoroughly research this goal,
3. to break your goal into sub-goals,
4. to outline everything that you need to do to reach your goal, and
5. to evaluate your plan for potential problems.

Review Questions: True/False

1.______ Planning requires the ability to anticipate problems.

2.______ Consulting with others after you have put your plan together will cause you delays in reaching your goal.

3.______ If you construct your plan well enough, you will not have any problems achieving your goal.

See answers on page 17, Section 6.

Section 7: Exercise

Choose the one best answer for each of the following questions. After you have completed answering all five questions, check your answers with those on the next page.

1. What should be added to this statement to make it a better planning goal? "I want to improve my English mark this semester":

   a. a description of how to improve the mark
   b. a reason for wanting to improve the mark
   c. a way of measuring any improvement in the mark
   d. a more exact timeframe for improving the mark

2. Which one of the following gives the best description of a sub-goal?:

   a. a goal that you do not really need to worry about
   b. a goal that is less important than your own goal
   c. a goal that is a smaller part of a larger goal
   d. a goal that someone else is attempting to reach

3. Which one of the following would be the most reliable source of information on becoming a management consultant?:

   a. a newspaper article in The Journal
   b. an article in a psychology journal
   c. the opinion of a business professor
   d. a person who works as a management consultant

4. Which one of the following adjectives best describes a masterplan?:

   a. flexible
   b. strict
   c. short-term
   d. long-term

5. What should you do if you run into a problem that prevents you from reaching a goal that is important to you?:

   a. skip that part of the plan and move onto the next part
   b. go back to the beginning and start all over again
   c. ignore the problem and it will go away
   d. find out more about the problem

See answers on page 17, Section 7.

Answers to Review Questions and Exercise

Section 1:	1. true	
	2. true	
	3. false	Thinking about what can go wrong beforehand can help you to avoid problems or deal with them better should they arise.
Section 2:	1. true	
	2. true	
	3. false	Simple goals will usually have simple conditions.
Section 3:	1. false	Information gathering skills are critical.
	2. false	Knowledgeable people are excellent sources of information; published sources & people sources are both important.
	3. true	
Section 4:	1. false	You may actually save time because sub-goals keep you better organized.
	2. true	
	3. true	
Section 5:	1. true	
	2. false	Every person is unique and may require a unique set of sub-goals and timeframes.
	3. true	
Section 6:	1. true	
	2. false	Finding out how others overcame problems can save you time and energy.
	3. false	Some problems just cannot be anticipated.
Section 7:	1. c	
	2. c	
	3. d	
	4. a	
	5. d	

Appendix B

Educational Objectives

Educational Objective: knowledge of a five stage planning process.

Type: Intellectual Ability/Skill (Bloom, 1956)

Main Objectives:

#1	#2	#3	#4	#5
know how to describe planning goals	know how to gather information	know how to create sub-goals	know how to make a master-plan	know how to evaluate a master-plan

Enabling Objectives: (supplementary concepts)

#1	#2	#3	#4	#5
know how to set standards for goal attainment	know how to locate information	know how to chose guidelines	know how to sequence sub-goals	know how to anticipate problems
	know how to collect information		know how to check for conflict with other goals	know how to create ways around obstacles
	know how to evaluate information			know how to revise planning goals

Appendix C

Instructional Booklet Content & Multiple-Choice Test Items

Section 1. The Stages of the Planning Process

	Concept	Analogy	Example
Main	.planning increases your chance of reaching your goal	.when travelling, knowing how you will get to your destination increases your chance of arriving	.occupational entry plan increases your chances of successfully entering an occupation
Supplementary	.planning starts with a clear goal	.travelling starts with knowing where you are going	.entry plan starts with knowing about the occupation that you want to enter
	.researching your planning goal increases awareness of options	.maps etc. let you know about alternate routes	.occup. info. increases your awareness of ways to enter the occupation
	.sub-goals divide a large goal into smaller goals	.stop-overs allow you to break your long trip into several short trips	.entry plan breaks entering an occupation into smaller steps
	.masterplans keep you organized & lets you know how well you are progressing	.maps etc. keep you on course & tell you how far away you are from your destination	.entry plan keeps you organized & lets you know how well you are progressing in entering the occupation
	.planning helps you eal with problems that may arise	.being prepared for emergencies prevents delays	.knowing about problems beforehand helps you to overcome them better

Section 2. Describing Your Planning Goal

	Concept	Analogy	Example	Item
Main	.goal of the plan describes the outcome	.your destination is Vancouver	.occup. goal is to become a laboratory technician	11 20
Sup	.outcome must be clear	.budget, # days your want to be away	.amount of money & time you are willing to spend to become qualified as a lab tech	29 6
	.standards allow you to measure your progress towards your goal & should be easy to apply	.you do not want to spend more than $500 or take more than two weeks off over Christmas	.annual budget of $10,000 and can spend three to five years as a full-or part-time student	1 18

Section 3. Gathering Information

	Concept	Analogy	Example	Item
Main	.finding out as much as possible about your goal can increase your options	.finding out different highway routes to Vancouver gives you more choices of routes to take	.finding out that your chances of getting into N.A.I.T.'s medical technology program are better if your marks are in the 70's	19 14
Sup	.information gathering involves locating & collecting information	.visiting travel information centers and talking to people who have driven	.reading occupational profiles & talking to people who work as lab techs	3 8

		to Vancouver		
	.all information should be crosschecked for accuracy	.talk to several people who have driven to Vancouver along different routes	.talk to a number of lab techs & people who hire them	27 22

Section 4. Breaking Your Goal into Sub-Goals

	Concept	Analogy	Example	Item
Main	,sub-goals divide a large goal into smaller goals	.determine places to stop along the way to Vancouver eg.Banff, Jasper, & Radium	.determine steps to qualify as a lab tech eg. academic upgrading, NAIT pre-tech prog, NAIT med tech program	5 10
Sup	.sub-goals can be useful measures	.Jasper is about one-quarter of the way to Vancouver, Banff one-half & Radium three-quarters of the way	.academic upgrading takes 1-2 years, N.A.I.T.'s program 1 year, N.A.I.T.'s medical technology program 2 years	13 16
	.sub-goals should make sense to the planner	.stopping in Jasper, Banff & Radium breaks the whole trip into shorter distances to travel each day	.taking upgrading courses before applying to NAIT increases your chances of getting into the medical tech program	25 30

Section 5. Making a Masterplan

	Concept	Analogy	Example	Item
Main	.a masterplan is an outline of everything that needs to be done in order to reach your goal	.a map indicates all of the towns and attractions along the way to Vancouver	.an occup. plan lists each thing that you need to do in order to qualify as a lab technician	7 4
Sup	.masterplan lists every sub-goal in the order that it must be reached	.Jasper comes before Banff, which comes before Radium on the route to Vancouver	.academic up-grading comes before NAIT's pre-tech and medical tech programs	23 12
	.masterplan takes into consideration your original standards	.stay in bed & breakfasts instead of motels to save $	.take no more than two up-grading courses at a time in order to also work part-time	17 28

Section 6. Evaluating the Masterplan

	Concept	Analogy	Example	Item
Main	.plans help you to deal with problems that may arise	.making sure that you have a spare tire, road map, and traveller's cheques	.apply to more than one up-grading program to make sure that you get into at least one	9 2
Sup	.deal with smaller problems by going back to stage 2 (information gathering)	.have phone number of bank available in case your wallet is lost	.improve study skills before starting your first academic course	15 26
	.deal with major	.take the Yellowhead	.join a study group	21

problems by going back to stage 1 (modify plan)	instead of the Banff-Jasper highway if there is an avalanche	or hire a tutor if Math 30 is more difficult than you thought

Section 7. Planning Exercise

Five multiple-choice questions (one per stage) that request the students to select the best answer from four possibilities planning process will assist the student to assess their ability to identify the five stages of the planning process. These multiple-choice questions are very similar to those on the multiple-choice test.

Appendix D

Events of Instruction

Event #1 - Gain the learner's attention in order to engage him/her in the learning process. Given that the student has chosen to be in this instructional setting, the assumption can be made that he/she is already motivated to become cognitively engaged in the instructional materials. The goal of this event then, is to heighten the student's interest by presenting a stimulus that is familiar enough for him/her to relate to and intriguing enough to stimulate his/her further curiosity. The idea of going on a trip to Vancouver was chosen as a stimulus that meets both of these criteria for most Edmontonians. Each section begins with an inviation to the student to consider an aspect of this travel scenario as it relates to the key abstract concept presented in that section.

Section 1. Invites the student to consider the similarities between entering a new occupation and taking a trip. The statement of the importance of how one prepares to deal with both kinds of events relates to the concept of planning increasing one's chances of reaching one's goals.

Section 2. Invites the student to imagine locating Vancouver on a highway map of British Columbia. Corresponds to the concept of being clear about what your goal is.

Section 3. Invites the student to imagine him/herself obtaining information about the routes to Vancouver from talking to others and collecting information at the A.M.A. Corresponds to the concept of finding out as much as possible about your goal.

Section 4. Invites the student to imagine him/herself calculating distances between Edmonton and Banff, Banff and Radium, Radium and Vancouver. Corresponds to the concept of dividing a large goal into several smaller ones.

Section 5. Invites the student to imagine him/herself figuring out what activities would be appealing to do along the route. Corresponds to the concept of outlining all of the actions that need to be taken in order the reach the final goal.

Section 6. Invites the student to imagine what could happen along the route to stop him/her from arriving in Vancouver. Corresponds to the concept of evaluating your plan for potential problems.

Event #2 - Inform learners of the objective. Section 1 states that the students will be better able to put together a plan to reach their goals as a result of completing the instructional booklet. The student is told that he/she will be able to assess his/her learning of the important ideas in each section of the booklet with the True/False questions at the end of each section, and an exercise at the end of the booklet.

Event #3 - Stimulate recall of prior learning. Each section draws an analogy between taking a trip (a familiar previously acquired concept) and planning for entery into an occupation, which is the specific example of planning used to clarify the (unfamiliar) abstract concepts contained in the five stage planning process.

> Section 1. Having a strategy for entering an occupation is like knowing how you will get to an unfamiliar destination.
>
> Section 2. Being clear about entering your new occupation is like being clear about where you going on your trip.
>
> Section 3. Researching the different ways to enter your new occupation is like researching the different ways to get to your destination.
>
> Section 4. Making a list of all of the steps required to enter an occupation is like figuring out where you are going to stop along the route to Vancouver.
>
> Section 5. Outlining what you have to do to enter your new occupation is like listing what you are going to do at each of the places that you stop along the route to Vancouver.
>
> Section 6. Evaluating your occupational entry plan is like thinking of what could go wrong on your trip.

Event #4 - Present the stimulus. A verbal (and visual) description of the analogy drawn between travelling and career planning is given. Appendix C outlines the common conceptual features of the analogy and example. Appendix E outlines the key features of the visuals as they relate to the verbal analogy.

Event #5 - Provide learning guidance to the student to facilitate the learning of the main and supplementary concepts. Within each section, a good career-related planning activity is first used to illustrate the key feature of the concept. Then, a poor career-related example is given, in order that the student can learn to discriminate between a good and poor application of each of he five planning concepts. In addition, key words that define the main and supplementary concepts within each section are underlined as they are introduced in that section.

Section 1.Good - Finding that first job in the new occupation soon after graduation.
Poor - Still looking a year after making the decision to enter the occupation because you did not obtain the right qualifications.

Section 2.Good - Statement: to find a job as a lab tech in a major hospital in Edmonton within five years.
Poor - Statement: to find a job in a medical setting.

Section 3.Good - Finding out what qualifications employers look for by talking to people employed employed in the field.
Poor - Applying for jobs without knowing what qualifications employers prefer.

Section 4.Good - Applying to take up-grading courses before trying to get into N.A.I.T.
Poor - Applying to N.A.I.T. without having the required courses and not getting accepted.

Section 5.Good - Studying part-time and working part-time in order to meet financial committments.
Poor - Studying full-time and working full-time and having to drop out of the program.

Section 6.Good - Join a Math 30 study group when the course turns out to be very difficult.
Poor - Failing Math 30 and not being able to apply to NAIT.

Event #6 - Elicit performance. Three True/False review questions at the end of each section give the student an opportunity to test his/her understanding of the three underlying abstract concepts presented in each section. The questions require the student to infer the main and supplementary concepts from the travel analogy and career planning examples given in the text.

Event #7 - Provide feedback. The answers to each of the review questions, plus brief informational feedback, are provided at the end of the instructional booklet.

Event #8 - Assess performance. Section 7 is a five-item multiple-choice exercise that allows the learner to evaluate his/her understanding of the five stage planning process. Each question is related to the five main educational objectives as follows:

Question 1 - main objective 1 (section 2).
Question 2 - main objective 3 (section 4).
Question 3 - main objective 2 (section 3).
Question 4 - main objective 4 (section 5).
Question 5 - main objective 5 (section 6).

Event #9 - Enhance retention and transfer. This event, while merging to a certain extent with event #8, also continues to occur after the instructional booklet is completed during the post-testing session. The post-test has two parts:

Part 1. 30 multiple-choice questions that assess the student's comprehension of all of the main and supplementary concepts presented in the instructional booklets. Each of the fifteen concepts presented in sections 2 to 6 is assessed by two questions.

Part 2. 6 open-ended short answer questions that assess the student's ability to recall and understand the five stage planning process.

The student will be encouraged to present his/her answers both verbally and visually. All answers (both verbal and visual) will be assessed according to their relationship to the verbal answer criteria.

Appendix E

Key Features of the Visuals

Section 1: Stages of the Planning Process

	Verbal Analogy	Visual
Main Concept	.when travelling, knowing how you will get to your destination increases your chance of arriving	.map of B.C./Alberta with the major routes between Edmonton & Vancouver drawn in .staring point (Edmonton) & final destination (Vancouver) are indicated with dark dots

Goldsmith's Analytical Elements:

1. Syntactic unity - dark thick border around the picture.
2. Semantic unity - Provincial borders marked with broken line; coast of B.C. indicated with shading; presence of Vancouver Island; highways indicated with lines; Edmonton and Vancouver indicated with large dots; presence of mountains indicated with symbols.
3. Pragmatic unity - clearly identifiable as a map of B.C. and Alberta by "typical Edmontonian"; similar images of this geographic location are used in nightly weather television broadcasts.
4. Syntactic location - use of shaded triangles to indicate mountain ranges; shading along the west edge of B.C. and south tip of Vancouver Island indicates the coastline.
5. Semantic location - triangluar symbols for mountains are shaded on one side to indicate mountainous terrain.
6. Pragmatic location - the incompleteness of the map (does not show all of either province) should not cause confusion to the adult viewer.
7. Syntactic emphasis - position of the page (upper left handcorner), size (approximately 25% of the page), isolation (presence of white space around the picture), complexity (most complex area of the picture is where the highway routes are drawn), directionality (highway routes are heaviest lines in picture).
8. Semantic emphasis - n/a
9. Pragmatic emphasis - verbal analogy equivalent is to the right and below the image on the same page.
10. Syntactic text parallels - picture is placed in the upper left corner of the page, drawing the viewer's eye first.

11. Semantic text parallels - use of verbal labels for two provinces and two cities, and title of picture is consistent with verbal analogy in text.
12. Pragmatic text parallels - maps of B.C. and Alberta are probably familiar to the typical Edmontonian; symbols used for the mountains, highways and cities are commonly used on maps of Canada, as well as other publications.

Section 2. Describing Your Planning Goal

	Verbal Analogy	Visual
Main Concept	.destination of the trip is Vancouver	.arrow starts in Edmonton and ends in Vancouver

Goldsmith's Analytical Elements:

1. Syntactic unity - same as visual #1.
2. Semantic unity - same as visual #1 except that the highway routes are replaced by a thick directional arrow from Edmonton to Vancouver indicating movement from Edmonton to Vancouver.
3. Pragmatic unity - same as visual #1, the map used is the same as the one in the previous visual.
4. Syntactic location - same as visual #1.
5. Semantic location - same as visual #1.
6. Pragmatic location - same as visual #1.
7. Syntactic emphasis - position, size, isolation (same as visual #1), complexity (all highway routes have been eliminated to reduce distraction for the viewer and increase the effect of the dark directional arrow), directionality and implied motion (arrow draws the viewer's eye to first Edmonton and then Vancouver).
8. Semantic emphasis - n/a
9. Pragmatic emphasis - same as visual #1.
10. Syntactic text parallels - same as visual #1.
11. Semantic text parallels - same as visual #1.
12. Pragmatic text parallels - same as visual #1 plus the design of the arrow is unambiguous.

Section 3. Gathering Information

	Verbal Analogy	Visual
Main concept	.finding different highways to get to Vancouver gives you more choice of routes to take	.inside of a travel information center with a person looking at a shelf of information brochures on B.C. & Alberta

Goldsmith's Analytical Elements:

1. Syntactic unity - same as visual #1.
2. Semantic unity - inside of a building is indicated by presence of walls, floor and shelf; function of the room is indicated by presence of brochures on the shelf and the labels on the brochures, shelf and wall.
3. Pragmatic unity - map on wall is identifiable as that of world, human figure in front of the shelf is clearly attending to the brochures, holding one in his/her hand and reaching for another.
4. Syntactic location - converging lines indicate foreground and background, foreground images overlap the background images in an unambiguous manner.
5. Semantic location - figure's non-gender specific features are clearly human and drawn in scale to the nearest object (shelf) with the use of perspective.
6. Pragmatic location - adult viewer will be familiar with the way that inside rooms are drawn and the probability that maps and shelves of geographically labelled information brochures indicate a travel information center.
7. Syntactic emphasis - position, size isolation is the same as visual #1, complexity (most complex area is shelf with brochures), directionality (viewer's eye is drawn to the shelf by the converging lines in the background).
8. Semantic emphasis - viewer's eye will be drawn to where the figure's eyes are looking - at the shelf.
9. Pragmatic emphasis - same as visual #1.
10. Syntactic text parallels - same as visual #1.
11. Semantic text parallels - use of verbal labels for the room and on the shelf; the title of the picture is consistent with the verbal analogy in the accompanying text.
12. Pragmatic text parallels - the images in the picture are probably familiar to adults who will have used information centers and shelves of information brochures before.

Section 4. Breaking Your Goal into Sub-Goals

	Verbal Analogy	Visual
Main Concept	.determine places to stop along the way to Vancouver	.calculator & page of figures overlaying the same map of B.C./Alberta used in visuals #1 &#2

Goldsmith's Analytical Elements:

1. Syntactic unity - same as visual #1.
2. Semantic unity - same as visual #1 except that only one

highway route is marked, overlaid by a sheet of paper with numbers on it and a corner of a calculator indicates that calculations are being done.

3. Pragmatic unity - sheet of paper is identifiable by the turned up corner; calculator is identifiable by the function keys and numbers on the display panel; the numbers on the paper are recognizable to those familiar with the distance between the two cities as the total mileage divided by a number; the map is the same as the one in visuals #1 and #2.
4. Syntactic location - the fact that the sheet of calculations and calculator overlay the map is indicated by the disappearance of the top right portion of the map.
5. Semantic location - the sheet of paper, numbers and calculator are drawn in scale to the map.
6. Pragmatic location - same as visual #1.
7. Syntactic emphasis - position, size and isolation same as visual #1, complexity (size and location of the sheet of paper and calculator draw the viewer's eye first, while the thickness of the highway route draw his/her eye next), directionality (the directional line that represents the visible side of the calculator also draws the viewer's eye initially to the calculations on the top of the page).
8. Semantic emphasis - n/a
9. Pragmatic emphasis - same as visual #1.
10. Syntactic text parallels - same as visual #1.
11. Semantic text parallels - word "days" indicates mileage divided by time, the function keys and numbers on the calculator indicates calculations, title of the image is consistent with the verbal analogy in the accompanying text.
12. Pragmatic text parallels - same as visual #1, image and function of the calculator will be familiar to adults in an educational program, and the calculations on the sheet of paper are clearly depicted and consistent with commonly known information about the distances between Edmonton and Vancouver.

Section 5. Making a Masterplan

	Verbal Analogy	Visual
Main Concept	.map indicates all towns & attractions along the route to Vancouver	.same map of B.C.& Alberta used in visuals #1 & #2 with route marked with symbols of skier (Jasper & Banff) & swimmer (Radium Hot Springs)

Goldsmith's Analytical Elements:

1. Syntactic unity - same as visual #1.
2. Semantic unity - same as visual #2, squares within the ovalare in the familiar grid of a wall calendar.
3. Pragmatic unity - the map is the same as the ones in visuals #1, #2 and #4; image of wall calendar is familiar to most; symbols for skier and swimmer are international.
4. Syntactic location - same as visual #2, calendar overlaps map to indicate a relationship between the two images.
5. Semantic location - same as visual #2, symbols are in scale with map.
6. Pragmatic location - same as visual #1.
7. Syntactic emphasis - position, size, isolation same as visual #2, complexity (area of highest complexity is primarily the calendar and then the symbols on the map), directionality (oval-like shape of the calendar contrasts with the angular shape of the other key features of the picture).
8. Semantic emphasis - human-like figures are very stylized and internationally recognizable.
9. Pragmatic emphasis - same as visual #1, calendar is located at top of the picture.
10. Syntactic text parallels - same as visual #1.
11. Semantic text parallels - same as visual #1, days of the week and numbers in the squares contribute to the recognizability of the image as a calendar.
12. Pragmatic text parallels - same as visual #1.

Section 6. Evaluating Your Masterplan

	Verbal Analogy	Visual
Main Concept	.be prepared for emergencies by having a spare tire, chains,traveller's checks	.clouds over a head indicating that he/she is thinking of three potential problems - avalanche on the route lost wallet flat tire

Goldsmith's Analytical Elements:

1. Syntactic unity - same as visual #1.
2. Semantic unity - thinking is indicated by three clouds above the head of a human figure; the avalanche is indicated by a road barrier and piles of snow, the lost wallet by wings attached to a wallet, and the flat tire by a back view of a car with a clearly deflated rear tire.

3. Pragmatic unity - the use of clouds above a head to indicate the thinking process is common in comic strip and books; the avalanche road barrier is common in the rocky mountains; the use of wings to indicate the something is going away or disappeared is common; and the meaning of an image of a deflated car tire is clear.
4. Syntactic location - n/a.
5. Semantic location - all three scenarios are drawn to scale in themselves; their location above the figure's head will be nonambiguous to most comic strip readers.
6. Pragmatic location - none of the images should be confusing to adult viewers.
7. Syntactic emphasis - position, size isolation same as visual #1, complexity (the area of highest complexity are the three thought clouds which contain thick lines and/or heavy lettering).
8. Semantic emphasis - humand figure's eyes direct the viewer to the three thought clouds, starting at the bottom of the picture.
9. Pragmatic emphasis - the human figure's eyes will cause the viewer to scan the picture from the bottom upwards.
10. Syntactic text parallels - same as visual #1.
11. Semantic text parallels - same as visual #1, words on the avalanche barrier add to the meaning of this scenario.
12. Pragmatic text parallels - meanings of the three scenarios will be clear to any viewer who has travelled by car, especially along a mountain route in the winter.

Appendix F

Multiple Choice Test
(* indicates the correct answer)

Instructions: Please choose the best answer for each of the following questions by filling in the circle on your answer sheet matching the letter of your answer.

1. Which one of the following would not be a good standard to use when trying to determine how well you are doing in reaching a goal?:

   a. how long it takes for you to reach your goal
   b. the number of things related to your goal that you get done
   c. a change in your behaviour that is related to your goal
   d.* how good you feel about your progress towards your goal

2. When Ralph discovered that a new Safeway Store was opening in his neighbourhood, he immediately quit his job across town and applied for one in this new store. Which of the following steps did Ralph forget to do?:

   a. figure out what his goal was
   b. find out more about his goal
   c.* evaluate the workability of his plan
   d. break his large goal into smaller ones

3. Which of the following is not a good example of researching a goal?:

   a.* getting an extension on your homework
   b. working in a lab to find a cure for cancer
   c. talking to your doctor about your health
   d. listening to the news to find out what happened that day

4. Keith has gathered all of the information that he needs about how to become a hotel manager. His next step should be to:

   a. look for any kind of a job in a hotel setting
   b. take a course in hotel management
   c. re-check the accuracy of his information
   d.* draw up an outline of how to become a hotel manager

5. When attempting to complete a large task, which one of the following guidelines would be the least useful?:

a. divide the large task into a number of smaller ones
b. do a small part of the task first, then another small part and so on until the large task is completed
c.* do everything that needs to be done to complete the task as time permits
d. decide when you want the task to be done before you begin it

6. Judy wants to find a job "working with people". Which of the following would be her best next step?:

a. find a job as a social services worker
b.* figure out what "working with people" means for her
c. enroll in a social services worker program
d. research jobs that involve "working with people"

7. Which one of the following gives the best description of a masterplan?:

a. a plan for reaching a goal put together by an expert
b.* a list of everything that needs to be done to reach a goal
c. a list of everything that could go wrong when trying to reach a goal
d. a list of all of the steps involved in putting a plan together

8. Which one of the following is the best way to obtain good information on a particular topic?:

a. look for articles on this topic in the newspapers
b. ask people that you know for information about this topic
c. look for articles on this topic in the library
d.* ask people who are knowledgeable about this topic for information

9. The best time to evaluate a plan is:

a. when you run into problems reaching your goal
b. after you have successfully reached your goal
c.* just before you start to try to reach your goal
d. when you are determining what your goal is

10. When Ken breaks his lawn mowing task into three parts, doing the front lawn before lunch, the back lawn by mid-afternoon, and the remaining part after diner, this is a good example of:

a. setting priorities
b.* creating sub-goals
c. clarifying a goal
d. evaluating a goal

11. Which one of the following goals is likely to be the most difficult to reach using a step-by-step planning approach?:

a. finding a job
b.* finding a friend
c. entering a university program
d. saving up for a holiday

12. Chris tends to forget to do parts of his school assignments. Which one of the following actions by Chris do you think might best help him to complete his assignments?:

a. draw up a checklist of all of his assignments
b. double-check each assignment before he hands them in
c. have someone else double-check each of his assignments before he hands them in
d.* draw up a checklist of all of the parts of each of his assignments

13. Which one of the following is the best reason for breaking a large task into smaller ones?:

a.* to allow yourself to check your progress in getting the large task done
b. to give yourself more time to get the large task done
c. to allow others to help you get the large task done
d. to allow yourself to get the large task done more quickly

14. When researching your goal, which one of the following actions would be the least helpful?:

a.* stop researching as soon as you find a way to reach your goal
b. discuss your goal with people who specialize in helping people to reach goals
c. talk to people who have reached goals successfully
d. discuss your goal with people who know you well

15. Which one of the following actions would most likely reduce the number of problems that you come across when trying to reach your goal?:

a. put together a very simple plan in the first place
b. follow the same plan that worked well for someone else
c.* think of what could go wrong and how to avoid these things beforehand
d. do not worry about potential problems, just cope with any that may arise as you go

16. Which one of the following is the best example of a sub-goal?:

a.* learning how to angle park before learning how to parallel park
b. deciding to get a driver's license now instead of next year
c. making two final driver's test appointments just in case
d. wanting to drive instead of take the bus to school

17. Which one of the following gives the best description of a masterplan?:

a.* an outline
b. a timeframe
c. an example
d. an endpoint

18. Which one of the following is the best example of clarifying a goal?:

a.* finding out what kind of marks you will need to get into the University of Alberta's Faculty of Science
b. finding out what the application deadlines are at the University of Alberta
c. taking an extra up-grading course in case you need it to get into the University of Alberta
d. deciding to apply to the University of Alberta's Faculty of Science

19. Which one of the following statements is the best example of researching a goal?:

a. using the number of pool lengths that you swim as a measure
b. putting together a weekly swim program
c.* finding out how to improve your swimming style
d. thinking of the problems that you may have sticking to your swim program

20. Sean has searched all of Edmonton for a good daycare for his son, so that he (Sean) can work on his goal of returning to school this fall. The daycare that is

closest to his home does not have a good program, while the one that does have a good program is on the other side of town. What would be the best thing for Sean to do next?:

a. wait until a good daycare opens up in his neighbourhood before going back to school
b. do not go back to school until he has found a good daycare that is close to his home
c.* spend some time clarifying his goal to go back to school
d. move to a neighbourhood that already has a good daycare

21. Which one of the following is the best reason for talking to others who have already reached goals that are similar to yours?:

[✓ a.] to meet people who have successfully reached goals
b. to help you to clarify what your own goal is
c. to help you to decide what your own goal will do for you
d.* to find out about potential problems that you may run into

22. Sue has collected conflicting information about university programs that might lead to jobs in personnel administration. Which one of the following steps would most likely help her to clear up her confusion?:

a. talk to the university department heads again
b. talk to several people who have graduated from these university programs
c.* talk to several people who work in personnel administration
d. talk to someone who is good at sorting out information

23. Which of the following rules is the best one to use when deciding on the timeframe of your plan?:

a. do not let deadlines that you cannot control influence your own deadlines
b.* take into consideration all deadlines, especially ones over which you have no control
c. fit everything that you need to do in order to reach your goal into a weekly timeframe
d. always give yourself as much time as possible to reach your deadlines

24. Bob has just discovered that he is too late to register with Continuing Education for the courses that he needs to get into U. of A.'s Faculty of Education next fall.

Which of the following actions is the best example of Bob modifying his goal to successfully cope with this problem?:

a. deciding to apply to U. of A.'s Faculty of Education for the fall after next instead of next fall
b.* obtaining the courses that he needs through correspondence school
c. registering in other courses still available through Continuing Education
d. applying to U. of A.'s Faculty of Arts (which does not require the courses that he is missing) instead

25. Which one of the following actions is not a good example of a sub-goal?:

a.* deciding to try for a 70% in English instead of a 75%
b. trying for a 70% in English and a 80% in Math this semester
c. trying for a 70% in English this semester, and an 80% in English next semester
d. scheduling weekly study sessions between now and Christmas

26. Which one of the following actions most clearly demonstrates that Maria has thought about what could go wrong on her camping trip?:

a.* she packed extra tent pegs and a camp stove
b. she decided to go camping for five days instead of ten
c. she wrote away for information on campsites beforehand
d. she decided on Jasper instead of Banff

27. Which one of the following would be the best way to check the accuracy of information heard on the evening T.V. newscast?:

a. read the next day's edition of The Sun
b. ask others who listened to the same newscast
c. ask your political science teacher the next day
d.* read all of the newspapers published the next day

28. Which stage of the planning process does the chart below best illustrate?:

	Week #1	Week #2	Week #3
Breaststroke	1 km	2 km	3 km
Sidestroke	.5 km	1 km	1.5 km

Butterfly	.5 km	1 km	1.5 km
Crawl	1 km	2 km	3 km

a. gathering information
b. evaluating a masterplan
c.* making a masterplan
d. describing a planning goal

29. Which one of the following is the best first thing to do when attempting to reach a goal?:

a. think about what could go wrong
b. figure out how you will reach the goal
c. list what you must do in order to reach the goal
d.* clearly describe what it is that you want as an outcome

30. Dan is on a weight-loss program and wants to lose twenty pounds by Christmas. Which one of the following is a good example of a sub-goal that he might have?:

a. to eat no more than 1500 calories a day
b.* to lose about two pounds a week
c. to never eat desserts again
d. to eat all that he wants during Christmas holidays

Appendix G

Open-ended Questionniare

Student Name: ____

Please answer the following questions without referring back to your instructional booklet. For each question, put down your answers in short sentences or point form. Feel free to use images or diagrams to clarify your written answers. If you need more space than that provided, just use the other side of the page.

Question #1: List the five stages of the planning process that are discussed in the instructional booklet, in the order that they are supposed to occur.

Question #2: What should be done in stage one of the planning process? How will these activities help the planner to eventually reach his/her goal?

Question #3: What should be done in stage two of the planning process? How will these activities help the planner to eventually reach his/her goal?

Question #4: What should be done in stage three of the planning process? How will these activities help the planner to eventually reach his/her goal ?

Question #5: What should be done in stage four of the planning process? How do these activities help the planner to eventually reach his/her goal?

Question #6: What should be done in stage five of the planning process? How do these activities help the planner to eventually reach his/her goal?

Thank you for your participation in this research project! Please do not forget to come to the information session on your learning style, which will include study suggestions.

Appendix H

Individual Differences Questionnaire- Short Version
(and word changes made to Hiscock's original version- see
last page)

INSTRUCTIONS

The statements on the following pages represent ways of thinking, studying and problem solving which are more or less true for different people. Read each statement and decide to what extent it is true or false for you. Then indicate your answer on the sheet by putting the letter that corresponds to how you feel about each statement to the left of that statement.

There are five choices for each statement. The choices are lettered A through E. The stronger your agreement with the statement the closer your answer should be to E. The stronger your disagreement with the statement the closer your answer should be to A. If you neither agree nor disagree with the statement, chose answer C.

A	B	C	D	E
DISAGREE STRONGLY	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	AGREE STRONGLY

Answer the statements as carefully and honestly as you can. The statements are not designed to assess the goodness or badness of the way you think. They are attempts to discover the methods of thinking you consistently use in various situations. There are no right or wrong answers.

Answer every statement even if you are not completely sure of your answer. If there are any questions, please raise your hand.

A	B	C	D	E
DISAGREE STRONGLY	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	AGREE STRONGLY

1. I have no difficulty expressing myself in words.

2. Listening to someone retell his experiences does not usually arouse mental pictures of the events being described.

3. When reading stories I usually form a mental picture of a scene or room that has been described.

4. Essay writing is difficult for me.

5. By using mental pictures of the parts of a problem, I am often able to arrive at a solution.

6. I enjoy being able to reword my thoughts in many ways for variety when both writing and speaking.

7. I enjoy visual arts, such as paintings, more than reading.

8. I tell jokes and stories poorer than most people.

9. I enjoy doing work that requires the use of words.

10. My daydreams are sometimes so vivid I feel as though I actually experience the scene.

11. I often use mental pictures to solve problems.

12. I find it difficult to find enough synonyms or alternate forms of a word when writing.

13. I have difficulty expressing myself in writing.

14. My knowledge and use of grammar need improvement.

15. I would rather work with ideas than words.

16. I enjoy learning new words and incorporating them into my vocabulary.

17. I do not have a vivid imagination.

18. I can easily picture moving objects in my mind.

A	B	C	D	E
DISAGREE STRONGLY	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	AGREE STRONGLY

19. I find that I am more critical of writing style than content when reading literature.

20. I can form mental pictures to almost any word.

21. I have only vague visual impressions of scenes I have experienced.

22. I can easily think of synonyms for words.

23. I think that most people think in terms of mental pictures whether they are completely aware of it or not.

24. I am able to express my thoughts clearly.

25. My powers of imagination are higher than average.

26. I consider myself a fast reader.

27. I have a large vocabulary.

28. I find it easy to visualize the faces of people I know.

29. My marks have been hampered by inefficient reading.

30. It bothers me when I see a word used improperly.

31. I can easily form a mental picture of Prime Minister Mulroney.

32. I am fluent at writing essays and reports.

33. I can close my eyes and easily picture a scene I have experienced.

34. I feel a picture is worth a thousand words.

35. I cannot generate a mental picture of a friends face when I close my eyes.

36. When someone describes something that happened to him, I sometimes find myself vividly imagining the events that happened.

A	B	C	D	E
DISAGREE STRONGLY	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	AGREE STRONGLY

37. I can add numbers by imagining them to be written on a blackboard.

38. When I hear or read a word, a stream of other words often comes to mind.

39. I seldom dream.

40. I read rather slowly.

41. I am usually able to say what I mean in my first draft of an essay or letter.

42. I am good at thinking up puns.

43. I never use mental pictures or images when trying to solve problems.

44. While have often seen pictures of him, I cannot remember exactly what President Reagan looked like.

45. I often remember work I have studied by imagining the pageon which it is written.

46. Studying the use and meaning of words has become a habit with me.

47. I speak or write what comes into my head without worrying greatly about my choice of words.

48. Not enough people pay attention to the manner in which theyexpress themselves.

49. I enjoy solving crossword puzzles and other word games.

50. I find it difficult to form a mental picture of anything.

51. My dreams are extremely vivid.

52. I have better than average fluency in using words.

53. I read a great deal.

A	B	C	D	E
DISAGREE STRONGLY	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	AGREE STRONGLY

54. I am continually aware of sentence structure.

55. My thinking often consists of mental pictures or images.

56. I do not form a mental picture of people or places when reading of them.

57. I often have difficulty in explaining things to others.

58. My daydreams are rather indistinct and hazy.

59. I find it easier to learn from a demonstration than from written instructions.

60. I often enjoy the use of mental pictures to remember the past.

61. I often use mental images or pictures to help me remember things.

62. I take great pains to express myself with precision and accuracy in both verbal speech and written work.

63. I have never done well in learning languages.

64. The proper use of words is secondary to the ideas and content of speech of writing.

65. I am disturbed by people who argue about word usage.

66. I have difficulty producing associations for words.

67. I often have ideas that I have trouble expressing in words.

68. Just before falling asleep I often find myself picturing events that have happened.

69. I prefer to read instructions about how to do something, rather than have someone show me.

A	B	C	D	E
DISAGREE STRONGLY	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	AGREE STRONGLY

70. I am a good story teller.

71. I spend very little time attempting to increase my vocabulary.

72. I sometimes have difficulty recognizing a character from one scene to another in the same movie.

Word changes made to Hiscock's original version:

item #	from " "	to " "
1.	"verbally"	to "in words"
2.	"recount"	to "retell"
	and "incidents"	to "events"
5.	"elements"	to "parts"
6.	"rephase"	to "reword"
	and deletion of "sake"	
31.	"President Nixon"	to "Prime Minister Mulroney"
44.	"Johnson"	to "Reagan"
60.	"reminisce"	to "remember the past"
65.	"quibble"	to "argue"